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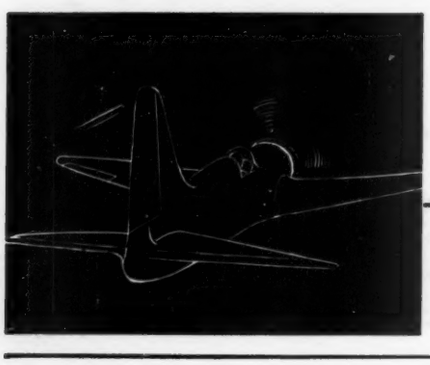

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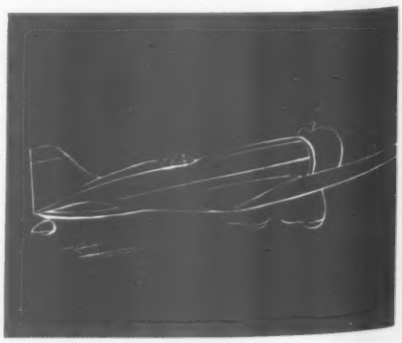

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AVIATION *for April, 1936* ★ ★ ★ ★ ★ ★

What Chance Has the Pursuit?

A French View

By C. Rougeron

Thanks to M. Henri Bouché, distinguished editor of L'Aeronautique,* Aviation *has been able to secure this discussion by an outstanding French authority of the relative merits of the heavily-armed aerial cruiser and the single-seater. Readers will find it of interest to compare M. Rougeron's ideas with those of Commander Scaroni and Major Stewart as published in October and November, 1935.

THE single-seat fighter has long been recognized as the type best adapted for aerial combat. Because of its armament and its maneuverability, it makes a most dangerous adversary. Most important, its speed permits it to force a fight with slower ships, and the same speed superiority makes it possible to conclude combat at any time.

"L'Avion de Bataille" or the heavily armed aerial cruiser in which the Italian General Douhet saw the essential elements of military air power, seeks superiority in another way.

"To gamble on speed for safety and striking power," wrote Douhet, "is to accept very long odds. In aerial combat it is concentration of fire that determines the victory. Speed is useful only to engage the enemy or to run away from him. Even a slow airplane may be armed in such a way as to set up a barrage of fire around it that offers effective protection against the swiftest pursuit plane. A formation of such airplanes may easily fight off an attack by single-seaters, even if it cannot avoid the attack nor pursue the attackers."

There are no heavy bombers built today without the three gun positions essential to lay down a complete barrage around them. A great deal of ingenuity has been expended on the problem. Armament has been so arranged that not even the smallest sector is without defense. For example, guns mounted in the extreme tail of the airplane have long been the rule for large British bombers. Perhaps the latest Boeing 299

marks a peak of effort so far undertaken to arm a bomber to prevent approach by pursuit planes.

But do these latest bombers, bristling with machine guns and with small cannon fulfill the hope of the disciples of Douhet? Are we approaching the time when the pursuit airplane must share the domination of the air with this newer type in the same way that sea power has been divided for the last 50 years between the torpedo boat which is too swift to be attacked and the cruiser, too powerful to be approached?

Speed in formation combat

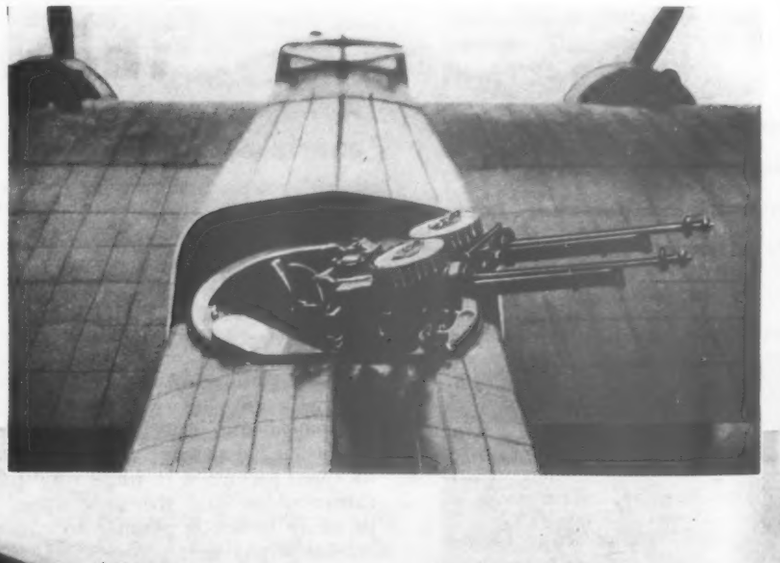
The Douhet philosophy rates speed well down in the list of desirable attributes. But Napoleon maintained that the key to victory was simply in outnumbering the enemy at decisive points. If his formula is of any value in aerial fighting, speed becomes of primary tactical importance. On the ground, it is possible to replace a concentration of troops with a concentration of fire. For example, machine gun fire may be brought to bear on any desired point from distances up to a mile and a half, and artillery fire from upwards of 6 to 10 miles. But the effective range of attack from an airplane is of the order of 100 to 150 yd. so that ability to get within effective range is very important. Only speed superiority will permit the concentration of attacking forces that will lead to victory.

The maneuverability which single-seaters have as a corollary to their high speed goes a long way toward balancing out the apparent power of the heavy concentration of fire of the aerial cruisers. In his "War of 19—" Douhet conceded the victory a little too easily to the German battle fleet of General Von Reuss over the combined Franco-Belgian pursuit. The powerful planes (2,000 to 6,000 hp. each) of the Von Reuss forces, advancing in successive waves of six to ten divisions of nine airplanes each, are supposed to encounter only scattered pursuit planes which expend their efforts in vain individual attacks. This, of course, would be utter foolishness, for any pursuit ships thrown against the attackers would naturally concentrate their efforts against one or two divisions of each wave and thus take advantage at each attacking point of the superiority which Douhet himself attributes to a concentrated force. Under such conditions high speed of the pursuit would be essential.

Speed in individual combat

But does superiority which arises from superior speed actually make as much difference in practical aerial combat as it might in surface warfare? Would it succeed in breaking up the

A wider field of fire aft is obtained for the Breguet fighter by narrowing the fuselage sharply behind the rear cockpit.



The Amiot 143, typical of modern bombers armed with the three firing positions essential to lay down a complete barrage about it. Note location of rear gun under the fuselage for which details are shown on preceding page. Right: Rear gun position of the Amiot 143 to protect against attack from above and to the rear.

Typical of modern turret design, the forward gun position of the Amiot 143.

balance of power and lead to the complete destruction of one of the adversaries with only moderate loss to the other which, after all, is the aim of all warfare? Or rather, should aerial combat be considered not as a group action but as a succession of individual combats, the final decision being the totalizing of the defeats and the victories?

In individual combat, speed superiority has always been held in high regard. Today the point has been reached where high speed is as valuable as an element of defence as for attack.

During the war of 1914-1918, it was quite possible for the gunner of a bomber to take careful aim and to apply the proper corrections to his gun during the period of a diving attack by a single-seat fighter. Furthermore, if the initial attack failed and the pursuit pilot pulled away from his target, he ran into considerable danger by being in the field of fire of the rear machine-gunner for several seconds. But what risk can there be for the pursuit pilot when diving speeds today are about 380 m.p.h. and tomorrow may be 500 m.p.h.?

If an attacking pursuit pilot had to lay his course directly toward his target, it would be a serious liability to him, as it would permit the defending machine-gunner to point his gun without haste and without having to bother about making any kind of correction. This situation would obtain, however, only if the pursuit pilot were attacking a stationary target. As an argument it is of no consequence in these days when both the attacker and the target move at very high speeds. To strike a moving target a pursuit pilot must fire well in advance of his objective, and his course will, therefore, not be directed toward the objective.

Assume a pursuit plane making a diving attack at 350 m.p.h. against a bomber or cruiser, traveling at 250 m.p.h. By the time the two ships would be within effective firing range, (about 300 ft.), the rear machine gun defending the larger ship would have to be traversed at a speed of 59 deg. per second and at the same time the pursuer would have to be "led" by about 7 deg. At the moment when the pursuit ship cuts through the course of the bomber about 100 ft. astern, its angular speed at the moment of passage is about 187 deg. per second.

Thus at modern fighting speeds how is it possible for a defending machine-gunner to figure out the necessary corrections at critical moments and aim his gun during that fraction of a second when his fire might possibly be effective? The speed of transmission of light sensation in his optic nerve cannot follow the acceleration of his target. The time required to adjust his vision is more than that in which any action he might take would be effective.

Weight of armament

The outstanding characteristic of a battle plane in the Douhet manner is the weight of its armament. But in combat, the guns that count are those which may be brought to bear on the enemy and not necessarily the total number carried. The nine 16-in. rifles of the battleship "Nelson" are extraordinarily effective because they can concentrate their fire on any floating object. Douhet arms his hypothetical battle cruiser with "a 37 mm. cannon forward, a 25-mm. gun behind the wing, two 20 mm. guns on the flanks, and a 12 mm. machine gun protecting the machine below." It is too much to hope, however, that the total weight of this armament could be concentrated against any single adversary. In many sectors only one of the five guns could possibly be effective, and it is exactly in those sectors that the ship would be attacked.

Neither has the very heavy airplane the monopoly on heavy armament. As a matter of fact larger caliber guns are better adapted to mounting on pursuit planes because the mass of the engines makes an ideal point of anchorage. [See description of the motor-cannon given by Major Oliver Stewart, AVIATION, December, 1935]. Under ordinary circumstances, 12 mm. machine guns or 37 mm. fixed cannon are excessive, but if some day such calibers prove to be necessary, it will probably be found that it will be just as easy to maneuver them as fixed guns on a small airplane as to handle them from the best of counter-balanced turrets on a larger ship.

Gun concentration

Is a heavy concentration of guns on a single airplane a factor of superiority? From a tactical viewpoint it is somewhat disturbing to see large quantities of armament concentrated in a single unit. Would not the attacking forces be less vulnerable if the same tonnages were divided up into a squadron of smaller airplanes? Neither airplanes nor engines are sold by the piece—engines are bought at so much a horsepower and airplanes at so much per ton of structural weight. For the same total expenditure, therefore, the same number of cannon and machine guns might as well be distributed among a number of pursuit planes as concentrated in a single battle plane. Distributed, more of them could be brought to bear on any particular objective than they might if they were concentrated.

At the extreme limit of effective fire, (and because of his machine speed and maneuverability the pursuit pilot may select the distance of engagement) bullets which miss one machine gunner of a large plane have a good chance of striking other machine gunners, engines or other vital parts of the airplane. The pursuer, on the other hand, runs little risk of being struck by bullets aimed at his squadron mates. At long ranges, especially, the relative loss in personnel, in engine power or in wing surface

(where explosive projectiles may be used) to the airplane of 10 tons weight is six times greater than it would be for six pursuit airplanes of the same total weight opposing it.

Also modern armament (either machine guns firing solid bullets or small cannon firing explosive projectiles) favors the pursuit ship. If both planes are armed with machine guns of the same range and caliber, the danger to both machines, if not equivalent, is at least comparable. If the pursuer is armed with a cannon, however, he will attack his adversary in such a sector and at such a distance that defending machine guns will be ineffective. And the pursuer armed with a machine gun only may (because of his greater speed and maneuverability) attack a ship fitted with a cannon in the sectors in which the cannon cannot be brought to bear.

Since superiority of armament is the keystone of the Douhet philosophy, if that element is missing, the whole theory collapses. As a matter of fact there is no other point on which his error is more certain. Although multiplication of armament may be valuable in fighting on land or sea, it is entirely useless in aerial combat. One must distinguish between total ballistic weight and effectiveness. Douhet's battle plane would be entirely at the mercy of a pursuer who might be 100 times less powerful in terms of foot-pounds of energy at the gun muzzles.

Field of fire

For defensive armament against pursuit, a single gun position or a single turret will always be unsatisfactory no matter how extensive its range of fire. The pursuer will always be aware of the disposition of the armament of his adversary. He will know the extent of the dead areas and will naturally make his attack in those sectors. For example, against a two-place machine with a single rear turret with a limited field of fire downward, the pursuit will attack from below. With the defender's field of fire limited by his own tail surfaces, the pursuit will attack from the rear. If the fuselage and tail surfaces are designed in such a manner as to permit an almost unbroken field of fire to the rear and below (as in the case of certain French airplanes in which the fuselage aft of the cockpit has been very much reduced in cross-section) the single-seater will attack from the front.

For defense, probably the least that can be provided are the two upper-turrets and the one under-turret as used on the latest French multiplace de combat.

Design of turrets

Turrets are obviously sources of high parasite resistance and it is quite a problem to keep their drag low and at the same time maintain their effectiveness as gun positions. By using tail guns and batteries of machine guns in "blisters" along the fuselage (as in the most recent British and American practice), all dead areas may be eliminated and, at the same time, a satisfactory speed may be attained. These solutions all have the same basic idea in common. Instead of using a few guns and attempting to obtain a very wide range of fire for each, the total number of guns is increased and the sectors in which each is responsible for defense are considerably narrowed.

Aside from increasing the defensive efficiency, a multiplication of defensive armament as outlined above has something to commend it from a structural point of view. On a large airplane the weight of the gun is no great consequence. The real trouble comes in mounting it to obtain a very wide range of fire. The best solution then is to replace the single gun mounted in a protruding rear turret by three or four guns placed in the fuselage, each having but a limited field of fire. The increase in weight carried is more than offset by the decrease in overall air resistance.

But, on the other hand, extreme segregation of this sort reduces the effectiveness of the gunnery. Whether an operator is provided for each gun position or whether one gunner moves from station to station, it is difficult to do any effective aiming, for the pursuing airplane passes through each defensive sector very rapidly. This is, of course, to the advantage of the pursuer for, in order to take correct aim, the defending machine gunner must be able to follow the target some time before opening fire to make the necessary corrections in his aim. Could we possibly expect a gunner to aim correctly if there suddenly emerged into his range of vision, say at 45 deg. of the expected azimuth, an airplane whose angular velocity might reach 100 deg. per second?

Battle cruisers in formation

In tactics, history has taught us to beware of precedents. Experience has always failed in forecasting correctly the value of a new implement of war or a new method of combat. Past experience might be helpful to demonstrate the errors of the Douhet philosophy if he had chosen new tactics for his combat aviation. But he made no novel proposition in this field. He retains the mass formations that the last years of the war of 1914-18 proved to be appropriate for slow, heavily armed aircraft. But since that time speed has doubled, bombers of 2 tons gross have grown to 15 tons, and armament has been changed. Therefore a triple extrapolation must be made (in speed, in tonnage and in armament) to prove theoretically the merit of the defensive power of mass formation under attack by pursuit planes under modern conditions.

There seems to be little question but that progress made in speed is all to the advantage of the single-seater. Also there is considerable question as to whether the mutual defense resulting from a mass formation is superior to individual defense. Once a mass formation of heavy aircraft has been broken up by combined anti-aircraft and pursuit attack, it would be very difficult for the cumbersome ships to reform rapidly into a compact unit.

That the progress made in armament favors the pursuit, however, there is no doubt. Single-seaters of the future will be armed with two types of guns, (1) the small caliber machine gun, effective up to about 100 yd. and (2) the small calibre cannon effective from several thousand feet away. There is nothing in the external appearance of the single-seater to indicate which type of armament is being carried. Although a mass formation might be excellent defense against a pursuit machine armed with a machine gun only, it would be entirely ineffective against the longer range cannon-plane. Viewed from the attacking position, the wing surfaces of the mass formation would represent 10 per cent of the total area of the forward field of fire. Such a target would be almost ideal for the attacker. He could empty his cannon from 3,000 ft. away and be sure of making at least one hit in ten.

One cannot overlook the changes that such developments will bring about in combat of the future. The cannon plane used for pursuit marks the end of the military usefulness of the Douhet formation. Such formations would be perfect targets for pursuit planes firing from positions well out of reach of the defending guns. Calculations indicate that out of each 1,000 lb. of ammunition fired, one or two of the large bombers would be shot down, having been hit at least fifteen times. Since the original invention of gunpowder there has never been such an efficiency of fire.

When Douhet conceived the idea of the aerial cruiser, he added to the offensive power of the bomber a defensive mechanism suitable against the pursuit planes of that period. The single-seat fighter has made such progress since that time, in speed and armament, particularly the latter, that it has entirely revolutionized methods of aerial combat just at the time when the Douhet type of heavy cruiser might have been expected to bear fruit. Napoleon held that military tactics should be revised completely every ten years. Technical progress is so rapid today, however, that if ten years were necessary to propagate new military doctrine, it would be out of date before it could even be adopted. This is just what has happened to Douhet's aerial cruisers.

HIGHLIGHTS of Germany's new airship, Graf von Hindenburg, scheduled to make her first visit to the United States early in May. Passengers, 50, crew, 40. Staterooms (two-berth, air-conditioned, hot and cold running water), promenade, dining saloon, writing room on A deck; smoking room, bar, baths, kitchen, crew and officers' mess, etc., on B deck. . . . Dimensions: overall length 813 ft., maximum diameter 135 ft. 2 in., gas capacity (normal) 6,710,000 cu.ft., (maximum) 7,063,000 cu.ft. . . . Power: four 1,100 hp. Mercedes Benz diesels, 16-cylinder water-cooled V type, 1,400 r.p.m. with 2:1 reduction to four-bladed propellers. . . . Performance: calculated maximum speed 84 m.p.h., cruising 78 m.p.h., normal range 8,700 miles; gross lift 471,800 lb., payload 42,000 lb. (15,400 lb. for passengers and food, 26,500 lb. for mail and freight).

L.Z.-129

Be Prepared!

A Boy Scout motto that holds a valuable idea for the airport operator

By M. G. Bishop
Pan American Airways

IN ALL FORMS of industry or transportation unforeseen events develop suddenly and a great deal depends on how well or how badly they are handled. It is as important to know how to deal with an emergency as it is to take all possible steps to prevent its occurrence. Especially around airports, lives and equipment may be saved by adequate preparation for emergencies.

The airport problem is especially difficult because most fields are situated well away from the usual sources of public and private aid. Municipal fire departments, public first aid stations, hospital ambulance services and medical aid are usually too remote to be counted upon for immediate use. The protection problem must therefore be faced squarely by every airport operator.

It is not the intent of this article to discuss in detail the fire and first aid equipment available. Each airport presents a different problem and the type and size of the equipment required depends upon local conditions. Manufacturers of fire fighting and first aid apparatus have had many years of industrial experience behind them and are able to give sound advice on the application of their products to an airport problem.

The provision of miscellaneous emergency equipment is something, however, that must be met locally. Emergency kits containing rope, bolt cutters, metal- and wood-cutting saws, crowbars, sledge hammers, small first aid kits, etc., should be available for instant use. At least one such outfit should be mounted on a cart or automobile for quick transportation to any part of the field. All emergency kits should be portable. They must be kept absolutely intact and reserved for emergency use only. Under no circumstances should tools or equipment from them ever be used for any other purpose. (See the Maintenance Note Book, page 139, for an unusual type of emergency kit.)

The maintenance of emergency kits is of utmost importance. Daily inspection to insure that everything is in its proper place and in good order requires but a few minutes and well repays the trouble. Chemical equipment especially should be regularly inspected and units re-charged periodically in accordance with the recommendations of the manufacturer.

But the finest equipment in the world will not in itself solve the problem of the sudden emergency. The training of personnel and the proper use of the equipment is of the greatest importance and requires considerable foresight and imagination on the part of the airport management.

Training can best be accomplished by individual instruction, group discussions, and special demonstrations, supplemented by regular emergency drills. The first principle to be taught, however, is that *any emergency at an airport should be considered a major emergency,* and all persons must be trained to stand by with their equipment ready at their respective stations until the situation is entirely under control.

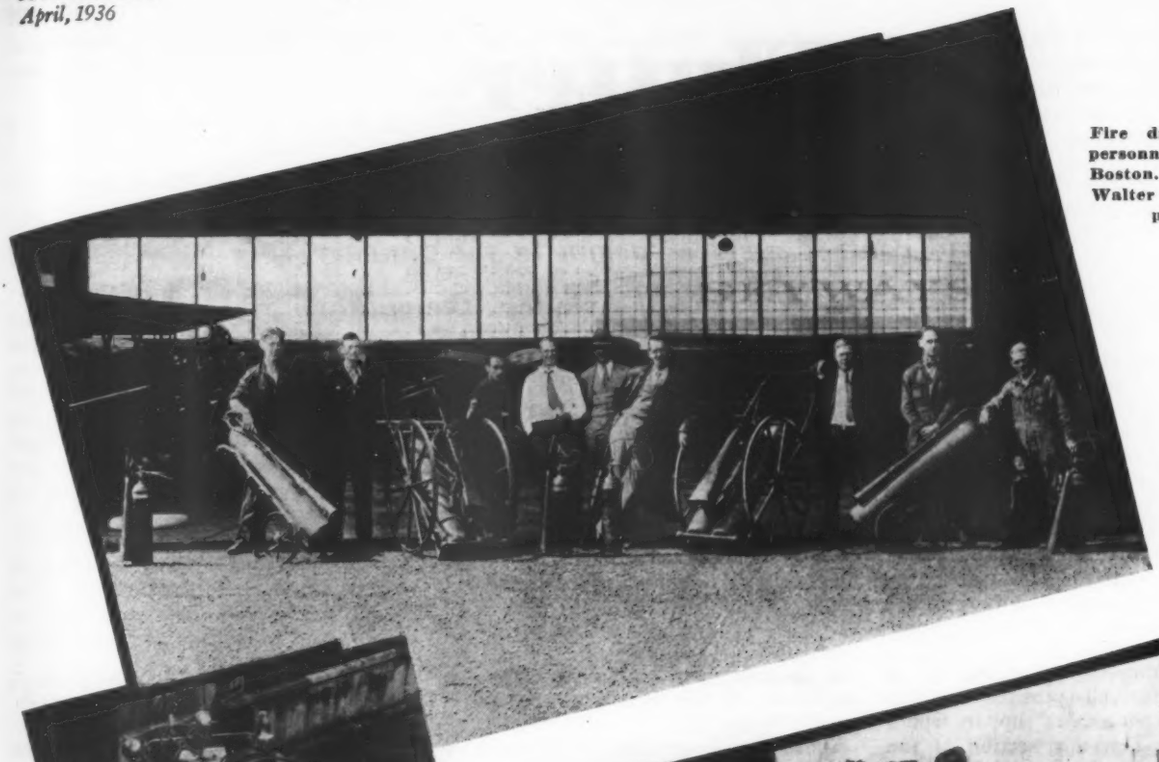
First step in training airport personnel for emergency work is to or-

First aid kits in a variety of shapes and sizes are offered by the Davis Emergency Equipment Company, Inc.

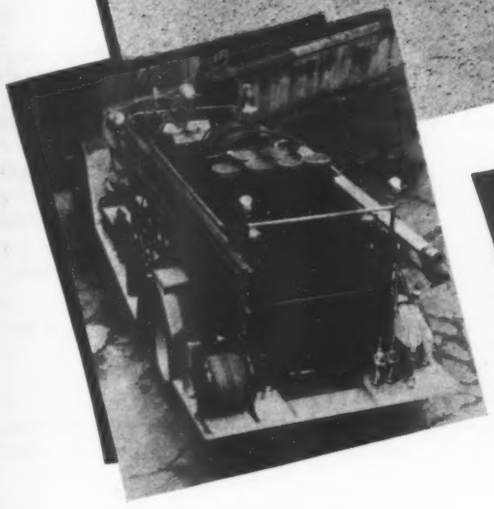
Pyrene's 2-qt., air-pressure-operated fire extinguisher provides a solid stream or fan spray.

The No. 754 Hangar type Pac-Kit is a commonly used representative of the Burroughs Wellcome "Tabloid" line.

The "Industrial" First Aid Cabinet is recommended for airport use by Johnson & Johnson.



Fire drill for airport personnel at East Boston. (Apparatus by Walter Kidde & Company, Inc.)



Typical of airport fire fighting equipment is this American La France truck in service at Allegheny County Municipal Airport.

A Naval Aircraft Factory crash truck built by Washington Equipment Corporation. Fittings are by Walter Kidde and have been approved by the Board of Aviation Underwriters.

ganize the working groups about the field into small units. For example, the employees in the administration building should be organized to handle any accidents in their vicinity and likewise the employees in each hangar, workshop or other building should be so organized. Line servicing crews should be assigned to emergencies occurring in the landing area. In other words, each working group should become more or less specialized in its immediate problem. But it is equally important that the smaller units be drilled to work together as a group. Each man should know not only what he is expected to do, but must understand exactly what his relation is to other members of his unit and of the unit to the group as a whole. Each individual unit should be separately drilled and at specified periods a group drill should be held for the entire personnel.

Obviously, leadership is of prime importance. Unit leaders must be specially trained to assume full command of an entire situation. Since emergencies may happen when the designated group leader is absent, second line leaders must be trained so that any one of them may assume command if necessary.

After each drill, group discussions of the drills are valuable, especially to bring out ways of improving the efficiency of the group. Every employee involved should be given opportunity to express his ideas. Such discussions encourage the employees to take greater interest in their own part of the work, and also are valuable in bringing new ideas to the attention of the management. The operation and use of emergency equipment should be demonstrated to and practiced by each group. Lectures on first aid are essential. Every employee should be required to know the elements of what-to-do-before-the-doctor-comes.

Although it is impossible to foresee in detail the nature of emergencies, drills and discussions are of vital importance in developing the idea that whatever is to be done is to be done calmly and quickly. Each act must have definite purpose, and each employee should be taught to perform his own task with positive assurance and with measured movements. An excited person is of no value whatever in an emergency, and employees must be drilled so that no matter what happens they can carry out their own jobs effectively and, at the same time, coordinate their own work with that of other members of their group. Constant drilling on minor details may seem unimportant or even silly at times, but airport managers will find that when circumstances arise where quick and positive action by field personnel is necessary to save lives or property, the effort will be more than repaid.

Flutter

Resuming the discussion of flutter in wings and control surfaces begun in the January and February issues of* Aviation, *the author considers herein certain theoretical and practical aspects of the problem of balancing.

By Manfred Rauscher

Assistant Professor of Aerodynamics
Massachusets Institute of Technology

THE complete balancing of a body for all possible motions of a given axis of support would require that any section of the body between two planes at right angles to the axis have its C.G. on the axis. The balancing masses would thus have to be distributed along the axis in exact proportions to the out-of-balance of the successive sections of the body.

In practice, such elaborate balancing is necessary only when the motion of the axis is very uncertain—perhaps for servo tabs, or for ailerons on wings with soft bracing and a small overhang. Even then, however, the balancing masses will be sufficiently "distributed" if they consist of two or three individual lugs, placed so that the surface is balanced against rocking of its hinge line about axes intersecting that line perpendicularly at infinity and at its two quarter points or end points. A similar subdivision of the balancing masses is also beneficial on surfaces having a marked tendency to twist under loads, such as long fabric-covered ailerons or flaps. But whenever the surface has adequate rigidity, and the general nature of the swinging motion of the hinge line can be anticipated with sufficient accuracy to allow a balancing of the surface for one fairly well defined condition, it is desirable to concentrate the balancing masses in one section—namely, where the amplitude of the vibration is greatest and where, consequently, a given mass has a maximum effect on the balance. That section is normally at the tip of the vibrating surface. Only when external bracing attaches abnormally close to the tip may there be a chance for the amplitude of the vibration to become greater in the bay.

The concrete problem of balancing is most simply discussed in connection with the balancing of the tail surfaces against flutter involving torsion of the fuselage and flapping of the rudder and elevators. The flexibility of the surfaces themselves plays a secondary rôle in this particular process and may be disregarded for the moment. Thus, if α (Fig. 16) is the instantaneous torsional acceleration of the fuselage about its axis XX, the linear acceleration at a distance z from the axis is αz; and if, at that station, an elementary strip of width dz of the movable surface has a statical moment dQ about the hinge line ZZ, it will react with an inertia couple $\alpha z dQ/g$,—the moment being proportional to the acceleration, and having (by assumption) the value dQ under an acceleration g. Also, dQ may be written as $dQ = q dz$, if q stands for the statical moment per unit width of section at the point considered. Thus, for the whole surface,

$$\text{Inertia Moment} = \frac{\alpha}{g}\int z\, dQ \frac{\alpha}{g}\int q\, z\, dz,$$

(About the hinge line)

the integrals extending over the length of the hinge line. Substituting for q its value $q = wx\, dx$, where w is the weight per unit area of surface at any point, a third expression is obtained,

$$\text{Inertia Moment} = \frac{\alpha}{g}\iint w\, z\, x\, dz\, dx,$$

(About the hinge line)

the integral to be taken over the area of the surface. If K is used to denote

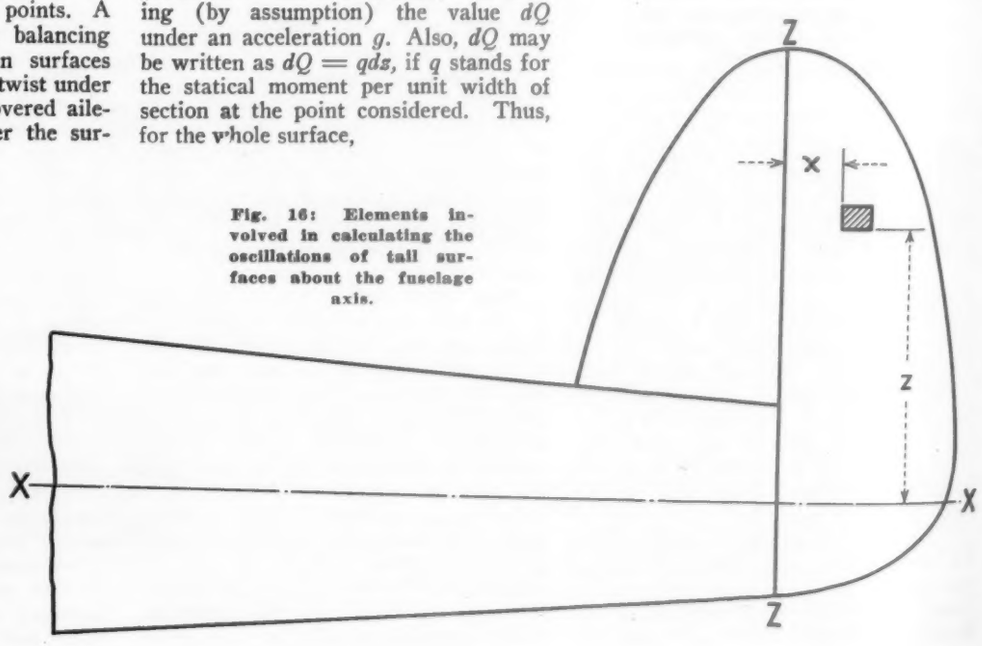


Fig. 16: Elements involved in calculating the oscillations of tail surfaces about the fuselage axis.

the *product of inertia* of the surface in mass units, i.e.,

$$K = \int\int \frac{w}{g} zx\, dz\, dx = \frac{1}{g}\int w\, zx\, dz\, dx,$$

there results finally the simple formula

$$\text{Inertia Moment (about the hinge line)} = a K.$$

In order that the movable surfaces be balanced under the motion considered here, it is then necessary that their products of inertia about their respective hinge lines and the fuselage axis be zero. The actual value of K may be found by a (generally graphical) evaluation of either of the three equivalent integrals,

$$\int z\, dQ, \quad \int q\, z\, dz, \quad \int\int w\, zx\, dz\, dx,$$

the first form being usually the simplest for a rough calculation, and the second the most accurate. A brief outline of the processes of evaluation follows:

Evaluation of K

The integral $\int z\, dQ$ may be obtained approximately as the summation $\Sigma z\, \Delta Q$, in which ΔQ is the statical moment about the hinge line of a strip of finite width Δz, and z is the distance from the axis XX to the middle of the strip.

A concentrated weight W will balance the surface if its coordinates x and z are such as to make $xzW + \Sigma z\, \Delta Q = O$.

The double integral $\int\int w\, dx\, dz\, dx$ is equivalent to the single integral $\int zx\ (w\, dA)$, or $\int zx\, dW$, in which dA stands for an element of area and $dW = w\, dA$ represents the weight contained in any particular element. The approximate value of this integral may be obtained as the summation $\Sigma zx\, \Delta W$, covering the whole surface, in which z and x are the coordinates of the C.G.s of the ΔWs.

An actual integration is more accurate, and need not be more laborious, than a summation of finite quantities. The integral in the second form given above—i.e., $\int q\, z\, dz$—is particularly suited for such a precise evaluation. The most direct method of obtaining this integral would consist in determining q at a number of sections suitably spaced along ZZ, multiplying each q by the corresponding z, plotting qz against z, and measuring the area under the curve. This process is, however, distinctly cumbersome—partly on account of the great back and forth variations in q at rib stations, which make it necessary to compute a relatively large number of points on the curve, partly because the statical moments of the ribs about the hinge line must themselves be calculated from more basic data. The work can be simplified by making use of the fact that

$$\int q\, z\, dz = \int\int w\, zx\, dz\, dx = \int q'\, x\, dx,$$

where q' stands for $w\, z\, dz$ and represents the statical moment about XX of a strip of unit width running parallel to ZZ at a distance x from the latter axis. Not only is q' easier to figure than q, because the cross-sections of the ribs now appear as concentrated loads at various points along the strip, but the curve of $q'x$ plotted against x is generally less jagged than that of qx plotted against z, thus allowing an accurate plotting by means of fewer points, as well as a more convenient measurement of the area under the curve.

A single weight W will balance the surface if the coordinates x and z of the C. G. of the weight are such that $xzW + \int q'\, x\, dx = O$. If several balancing weights are to be used, the condition to be satisfied is $\Sigma xzW + \int q'\, x\, dx = O$. With balances spread out over a considerable area, it is best to include the balancing effects directly in figuring q', and to adjust the weights until $\int q'\, x\, dx = O$.

It has so far been assumed that the hinge line is perpendicular to the

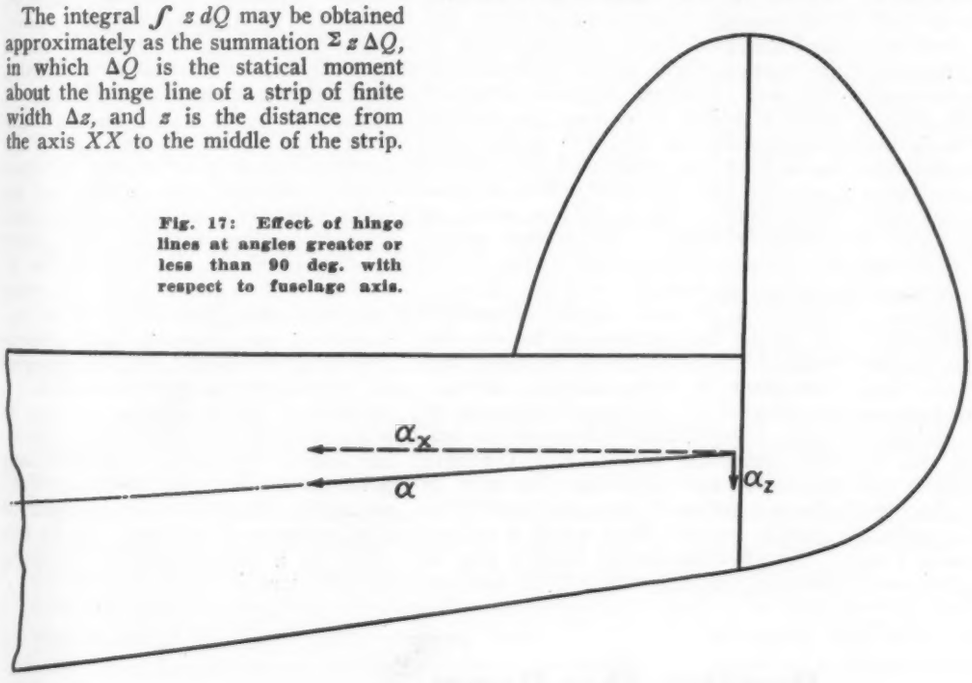


Fig. 17: Effect of hinge lines at angles greater or less than 90 deg. with respect to fuselage axis.

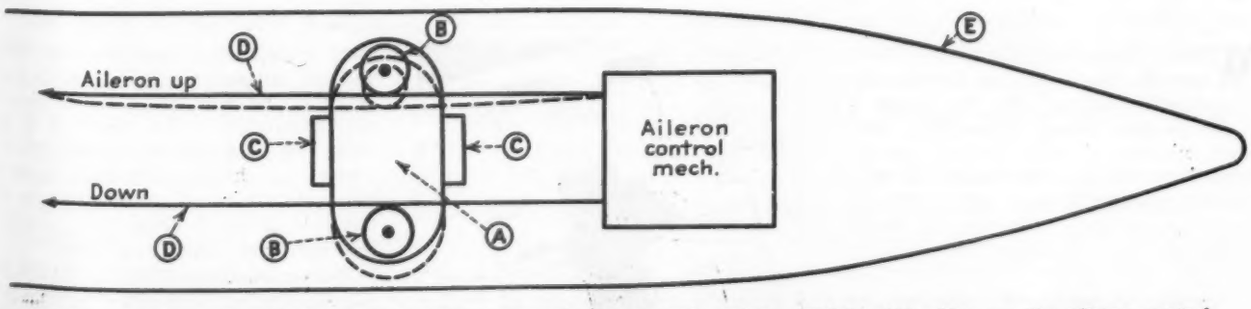


Fig. 18: A means of obtaining aileron balance through the control system. Weight (A) rides on the aileron control cables (D) on the pulleys (B). It is free to move vertically up or down between the guides (C). Upward acceleration of the wing (E) causes a downward displacement of weight (as shown by dotted lines) increasing tension on "up" aileron cable and causing ailerons to be held in normal position. Downward acceleration of the wing tends to shift weight to increase tension on "down" aileron cable. "Overbalance" may be attained by increasing mass of sliding weight to make ailerons move to oppose the wing motion.

torsional axis of the fuselage. The assumption is strictly justified only for the horizontal surfaces. Between the rudder hinge line and the fuselage axis, the angle is seldom 90 deg. But so long as the rudder post slants *backwards* with respect to the fuselage axis, as it generally does, the result of neglecting the slant is conservative (Fig. 17), because a motion of the rudder as part of the fin will now actually be secured with an unbalance that furnishes, under an acceleration α_x about XX, a moment accelerating the rudder at the rate α_z about ZZ. More specifically, the permissible unbalance is such that $\alpha_x K/I = \alpha_z$, or $K = I \tan\theta$, if I denotes the moment of inertia of the rudder about ZZ, and θ is the angle between XX and the fuselage axis. The effect in question is likely to become important only when the slant of the hinge line is pronounced, as on flying boats with hulls rising markedly toward the stern. What is generally of greater importance than the *direction* of the effective axis of torsion is its *location*. For a conservative estimate, the axis should be assumed in the lowest position that seems at all probable.

In flutter which involves principally motions of the tail surfaces relative to a fixed fuselage, the flexural deflections, instead of increasing linearly along the span, vary in approximately parabolic fashion. The result is that the influence of the tip sections of the surfaces is enhanced relative to that of the root sections. Balancing weights placed at the tips, and proportioned for fuselage-tail flutter of the type considered above, will thus be more than adequate in this case also. They may, however, be insufficient for a motion involving both twisting of the fuselage and distortions of the surfaces, because it is conceivable that the non-linear deflections due to one vibration might be opposed to the linear deflections due to the other, reducing the motion of the outer sections relative to that of the inner ones (see Fig. 10, page 26, AVIATION, February, 1936). For this reason, and because some torsional deformation of the fixed surfaces must also be expected, it is generally desirable to provide a balance slightly greater than that required for the rigid surfaces first assumed.

Aileron balance

The problem of balancing the ailerons, which remains now to be discussed, is generally similar to that of balancing the rudder and the elevators. Unless an aileron extends abnormally far inward, its hinge line remains very nearly straight as the wing vibrates. The axis about which the hinge line swings may be found quite closely by subjecting the wing to a load starting from zero at the root and increasing uniformly toward the tip (roughly representative of the loads actually associated with flutter) and drawing a straight line through the end points or quarter points of the hinge line. The center about which the hinge line rotates is where this line intersects its original trace. If the deflections of the wing under normal loading happen to be known, they may be used instead of those due to a triangular load. The difference in the result is slight, and on the conservative side. Lacking accurate deflection data, it is safe to assume the effective axis at 0.25, 0.20 and 0.15 of the semi-span from the wing root for aileron spans of 0.40, 0.70 and 1.00 semi-spans respectively. These figures refer to cantilever wings. On braced wings, the axis or rotation may ordinarily be assumed to coincide with the effective nodes. In all cases, balance is attained, as on the tail surfaces, by making the product of inertia of the movable surface about its hinge line and the axis of rotation of the hinge line equal to zero. Overbalance is desirable for reasons discussed before, and (in rare cases) because the hinge line may be slanting forward appreciably with respect to the axis about which it swings.

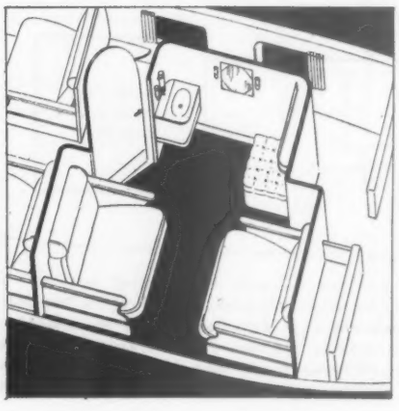
An effective aileron balance may be attained indirectly through the controls, without making K itself zero. To render balancing in the ordinary sense superfluous, it is only necessary to provide a mechanism that will tend to pull the ailerons up when the wing is accelerated upward, and down when the wing is accelerated downward. If the pull is just enough to hold the ailerons in position, the ailerons move as they would under perfect ordinary balancing. Effective overbalance results if the pull is sufficient to move the ailerons in opposition to the motion. An illustration of such a balancing mechanism is given in Fig. 18. The obvious advantage of the device is that it permits the use of ordinary ailerons without extraneous appendages—the whole mechanism lying inside the wing—and that the balancing effect from a given mass can be greatly increased through the favorable angularities in the cable pulls. A strong "overbalance" thus becomes attainable at but a slight expense in weight.

In concluding the discussion of balancing, attention is once more called to the possibility of clamping the movable surfaces in place, instead of balancing them. A rigid anchoring in position, rather than any mass balancing, is, for example, the natural means of keeping flaps from participating in flutter. A certain degree of elastic restraint (although not actually a clamping) of the controls toward their neutral positions results automatically whenever the hinge line of a surface suffers pronounced bending, for the surface tends to align itself so as to bend in the direction of its least stiffness. It would seem that this effect might be of distinct help on torsionally stiff ailerons extending far inboard, i.e., into a region of fairly high flexural curvature. A mechanism similar to that of Fig. 18 might also be used to produce clamping instead of balance. As previously pointed out (AVIATION, February, 1936) an elastic restraint on anti-symmetrical displacements of elevators can be provided by a torque member connecting the elevators.

Douglas Sky Room

WHAT a stateroom is to the "Normandie," or a drawing room to the "Twentieth Century," the Sky Room is to the Douglas Sleeper Transport. Airlines wishing to offer private accommodations to a limited number of their passengers may select a cabin arrangement for the DST with the Sky Room replacing the forward two sleeper sections.

Sleeping accommodations for two, or seating accommodations for four, are provided. The seats make up into an upper and lower berth, each 6 ft. 5 in. long. Complete private toilet and lavatory facilities are available. The equipment includes the usual reading lights, and call buttons, also a removable table. Heating and ventilation are automatically controlled. The doorway to the room opens in such a manner that the interior is shielded from the view of the main cabin. A passageway on the left side of the fuselage gives access to the buffet and cockpit forward.



Announcement has been made that the private compartment will be supplied on some of the DST sleeper transports shortly to be delivered to American Airlines. No schedule of tariff has yet been announced, but it is safe to assume that a substantial "extra" will be charged.

Editorials

AVIATION

Record of Progress

ONCE again AVIATION looks back over the record of the year that has just closed and casts up the score in terms of the years that have preceded it. Once again we are justified in giving to our study a title that was coined some years ago, for our record continues to be one of definite progress, a story of a steady march from small beginnings toward a future that few dare even yet to visualize.

Charts and tables are but feeble indices when, at best, they are outdated even before they can be drawn up. They are static when they should be dynamic. They give merely a snapshot of the instrument board of the industry.

Be that as it may, we have combed through all available sources of information to catch the picture as it stood at midnight of Dec. 31, 1935. This year we present it in a new form, as a supplement to this issue. It is to be found between pages 67 and 82.

On Questions of Fact

AT THE MOMENT we have no intention of attempting to decide the issues of the three-cornered "have-you-stopped-beating-your-wife," "where-were-you-on-the-night-of-June-5" argument that has been going on in Washington lately under the guiding hand of the good Dr. Copeland. At this point in the proceedings we would simply like to remind the distinguished senators that there is often little relationship between testimony given with apparent emotion in a loud voice and the facts of any case.

We would recommend to the committee a careful study of a survey of pilot opinion turned in a few days since by the Air Navigation Division of the Bureau of Air Commerce. Altogether, over 1,100 transport pilots with combined flying experience of close to 3,000,000 hours replied to the questionnaire. By and large, most of the men who fly the airways find conditions generally satisfactory. On the other hand, there are frank criticisms and numerous recommendations made to correct conditions that appear unsafe or unsatisfactory. Again, we are not going to attempt to strike the balance, or to detail the replies. That would be a job far beyond the limitations of our available space. Here, however, is a type of testimony offered to the committee that may fairly be considered as competent. At least it serves to get facts out into the open where they may be attacked properly. The combined opinion of 60-odd per cent of the 772 airline pilots of the country should draw a lot more water than the "emoting" of certain "experts" who, according to report, put on a swell show while "investigating" certain of the airlines.

It is high time that someone injected some realism into the sad business of Senatorial investigations. Already too much sheer blather has been allowed to escape into the public prints. Someone with the interest of the operators at heart had better keep an eye on things of this sort lest they go too far, and the lines lose all their customers. When congressmen and other "experts" stand up and weep down inquisitorial shirtfronts (with full benefit of press) about the parlous condition of air transportation in America, the laity can scarcely be blamed if it boards the Century rather than an airliner the next time it goes to Chicago.

Looking Forward

IF YOU LIKE to tilt back your chair, put your feet on your desk, and speculate on the future, you will find material worthy of your teeth in a slim pamphlet bearing the Smithsonian imprint titled "Liquid-Propellent Rocket Development" by Professor Robert H. Goddard of Clark University (Smithsonian Miscellaneous Collection, Volume 95, No. 3).

Whether or not you hold with the Buck Rogers school of thought that foresees interplanetary navigation in the 25th century on a par with the transcontinental trips of the 20th, you cannot laugh off Professor Goddard's work as too visionary to rate serious attention.

To be sure, after almost twenty years of experimental effort there are as yet no full-scale passenger-carrying rockets capable of interplanetary, or even lunar, exploration, but the work so far accomplished gives some clue as to the direction future development may take.

To date, rocket flights up to altitudes of 7,500 ft. at speeds well over 500 miles per hour have been achieved. More important—the problem of automatic stability seems to be at least on the way toward solution. Most important—practical fuel and combustion chamber combinations have been worked out that yield over 200 hp. per pound of motor—a real figure for internal combustion engine designers to shoot at!

Much of Dr. Goddard's work has been done under grants from the Carnegie and Guggenheim foundations. Although we have very little expectation of riding into outer space in a rocket ship in our own lifetime, yet we feel that a modest amount of continuous research in this direction is warranted from the results already obtained. We hope that means will be found to enable Dr. Goddard to carry on with his interesting experiments.

Flying Equipment

Canadian Cruiser

Noorduyn Norseman designed especially to meet conditions of Canadian service

BOB NOORDUYN is well known for his work as executive engineer with the old Fokker Company and later with Bellanca. His last job of design in the United States was the four-place cabin-type autogiro for Pitcairn. (AVIATION, November, 1932.) His latest efforts are concentrated in Noorduyn Aircraft, Ltd. of Montreal, Que., Canada. His latest design—the Norseman.

The Norseman is a light transport plane with features especially applicable to Canadian or other out-of-the-way flying conditions. It is of the high wing type especially favored by Canadian operators, and may be mounted on wheels, floats or skiis. Special attention has been paid to high cargo carrying capacity for low horsepower. The engine is a 420 hp. Wright Whirlwind, and the ship has been licensed for pilot and nine passengers or the equivalent in cargo. The cabin is large (190 cu.ft.) to accommodate bulky cargo, and is accessible from four different doors, one of which is almost 4 ft. wide to permit the rolling of standard 50-gal. gasoline drums on board without difficulty.

The design appears to be conventional, i.e., steel tube framing for fuselage and tail surfaces with fabric covering. Wings are also fabric covered. Trailing edge flaps appear on the portion of the wing inboard from the ailerons. Throughout, the ship has been designed to "Empire standard" requirements.

The characteristics and the performance of the ship appear in an accompanying table.

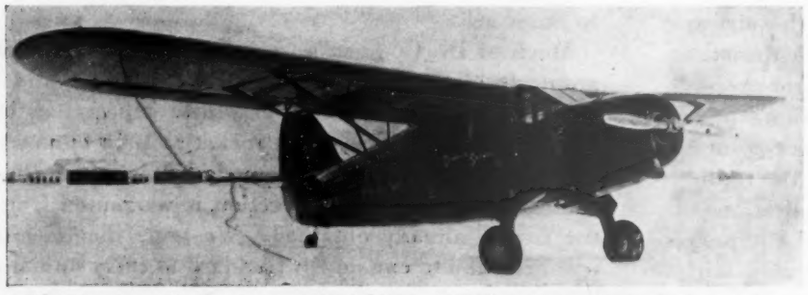
PAYLOAD

For 500 miles range, completely equipped, with flaps, controllable pitch propeller, electric starter, generator and battery, cabin heater, etc.

	Landplane	Skiplane	Seaplane
Freighter	1,950 lb.	1,705 lb.	1,425 lb.
Passenger	9 pass. plus 355 lb.	9 pass. plus 110 lb.	8 passengers

PERFORMANCE

	Landplane	Skiplane	Seaplane
High Speed	160 m.p.h.	148 m.p.h.	146 m.p.h.
Cruising Speed	140 m.p.h.	132 m.p.h.	125 m.p.h.
Landing Speed	53 m.p.h.	53 m.p.h.	53 m.p.h.
Climb	920 ft. per min.	840 ft. per min.	820 ft. per min.
Service Ceiling	16,500 ft.	15,500 ft.	15,200 ft.
Range (full tanks)	750 mi.	710 mi.	670 mi.



The Noorduyn Norseman as a land plane, (above) as a seaplane on Edo floats.

Whirlwinds De Luxe

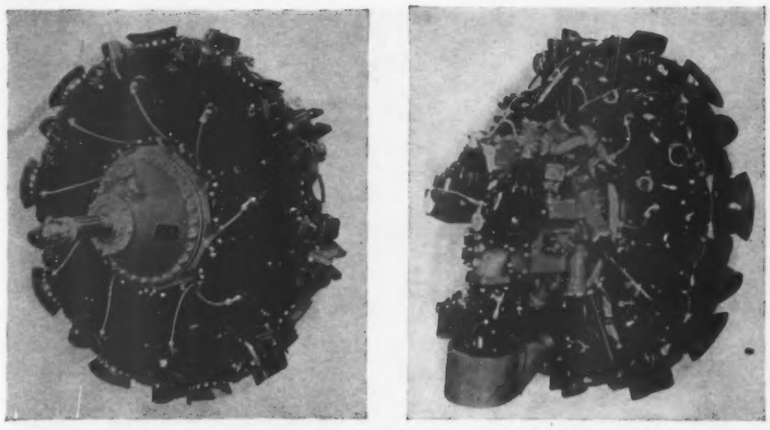
Wright announces engines in private owner range with transport features

TWO NEW ENGINES have lately been added to the Whirlwind line by Wright Aeronautical of Paterson, N. J. They are the seven-cylinder Whirlwind 320, rated at 320 hp. at 2,150 r.p.m. and the Whirlwind 450, rated 450 hp. for take-off and 420 hp. normal at 1,400 ft. A.T.C.'s No. 155 and No. 125 have been issued for the engines, respectively. Complete specifications for these engines were published under AVIATION's "American Engine Specifications," page 89, March, 1936 issue.

Outstanding feature of the new engines is the incorporation in their design of elements which heretofore have been available only in the larger sizes intended for transport and military service. In addition to providing special drive for generators, vacuum pumps for operating navigating instruments, mechanism for hydro-controllable propellers, and complete radio shielding, the new engines feature full pressure baffling, automatic valve gear lubrication and the Wright dynamic damper (see AVIATION, June, 1935).

Apart from the new features mentioned above, the 320 Whirlwind has all the basic elements of the older 235, 250 and 285 hp. series. It has, however, the highest compression ratio of the lot (6.3 to 1). It is designed to operate on 80 octane fuel.

The 450 Whirlwind is a further development of the Whirlwind 420 used by Commander Frank Hawks in setting several American and European speed records several years ago. It is also the



Latest in Whirlwinds. Front and rear views of the Wright Whirlwind 450 showing automatic valve gear lubrication, ignition shielding, pressure baffling and controllable pitch propeller valve.

engine installed in the most recent Lockheed Electras delivered to Eastern Airlines and Delta Airlines. It also has a ratio of 6.3 to 1 and is designed to operate on 80 octane fuel.

Grumman Fighter

Latest in single seaters delivered to Navy by Grumman of Farmingdale

ALTHOUGH Grumman's factory is less than 20 miles away from our offices, it was on Major Moseley's airport at Glendale, California, that we had our first look at the Navy's new Grumman F2F-1 single-seater in flying condition. We had seen them in process of construction at the factory, but the unfinished product did not give the impression of compact fighting efficiency as does the assembled machine. Something of what we mean can be judged from the accompanying illustration.

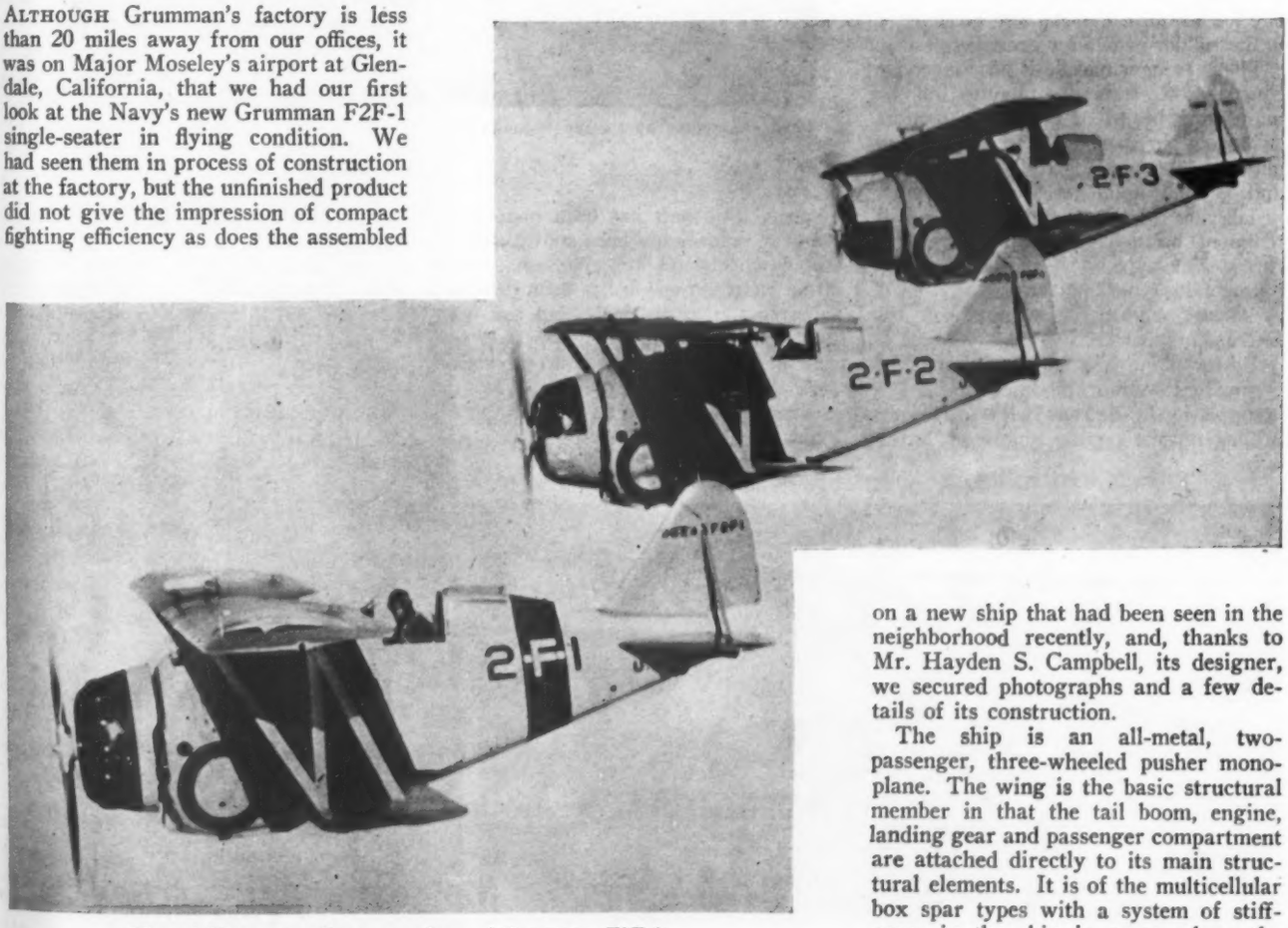
The ship is basically of metal construction with a deep semi-monocoque fuselage. Wing spars and ribs are of aluminum alloy with wing covering of fabric.

Landing gear is retractable in the usual Grumman manner. Wheels pull up into wells forward of the lower wing panel flush with the sides of the fuselage. Bendix wheels, shock struts and brake equipment are fitted. Tail wheel is full swiveling on the ground, is completely retractable in the air.

Cockpit covers, shown open in the photograph, slide forward to form complete enclosure. Provision is made for mounting full naval equipment, including two machine guns firing forward through the propeller disk, complete radio and emergency equipment.

Power plant is a Pratt and Whitney Twin-Wasp, Jr. rated 650 hp. at 7,500 ft. Propeller is a Lycoming-Smith controllable.

Overall dimensions: span, 28 ft. 6 in.; length, 21 ft. 1 in.; height, 8 ft. 6 in.; wing area, 230 sq.ft.; weight empty, 2,575 lb., gross weight, 3,735 lb. Top speed is reported in the neighborhood of 240 m.p.h.



Newest Navy pursuits, a squadron of Grumman F2F-1s.

Ford-powered

Campbell monoplane designed around automobile engine

WHILE spending a few days around Kansas City last month we heard occasional and generally favorable comment on a new ship that had been seen in the neighborhood recently, and, thanks to Mr. Hayden S. Campbell, its designer, we secured photographs and a few details of its construction.

The ship is an all-metal, two-passenger, three-wheeled pusher monoplane. The wing is the basic structural member in that the tail boom, engine, landing gear and passenger compartment are attached directly to its main structural elements. It is of the multicellular box spar types with a system of stiffeners in the skin in areas where the

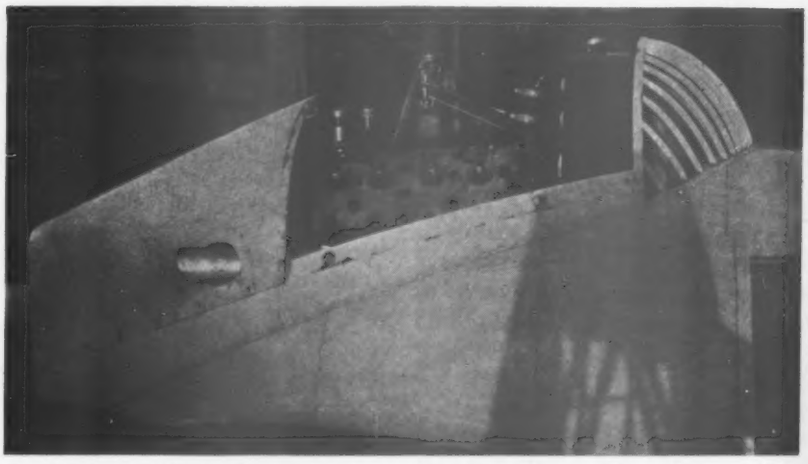
Ford powered all-metal monoplane by Campbell Aircraft Company of St. Joseph, Mo.

major part of the normal flight loads are carried. A very light structure has been achieved. Wings weigh 1¼ lb. per sq.ft.

The landing gear is of the 3-wheel type similar to the one developed by Fred E. Weick of the N.A.C.A. (see AVIATION, January, 1936). The two main wheels are attached directly to the main wing spars and are well to the rear of the center of gravity. They are equipped with Bendix shock struts with 15-in. travel. The nose wheel, also on a Bendix strut, has a 10-in. travel. The front wheel is similar in mounting to the front wheel of a bicycle, and is attached to the rudder pedals for ground steering.

The passenger nacelle is of monocoque construction. It is also mounted on the main wing beams of the center section. In layout it is similar to a standard automobile coupe. Seat is 50 in. wide, and is well upholstered. Dual rubber pedals are installed and the wheel is mounted on a control column of the throw-over type. As far as possible, automobile type instruments are used. A starter button is mounted on the instrument board.

Power plant is a standard Ford V-8 engine with minor modifications. The compression ratio has been raised by milling off the regular aluminum heads.

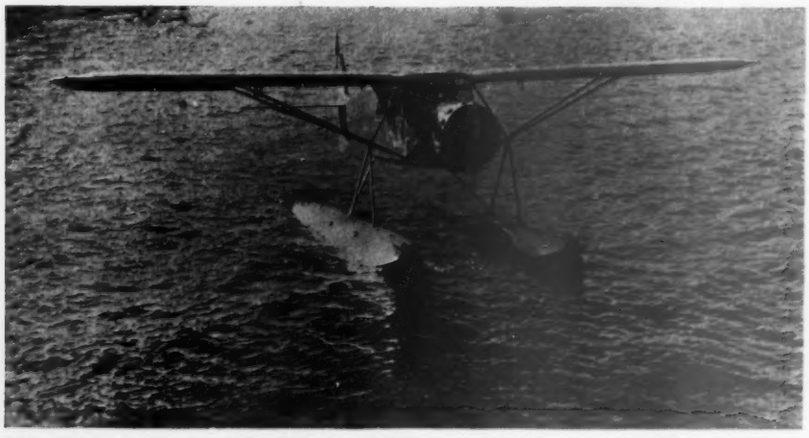


Ford engine in the Campbell monoplane. Note propeller mounting (extreme left).

a special camshaft has been installed, a 2-1 gear reducer has been substituted for the flywheel and transmission, and a 30-in. shaft extension has been provided to drive the propeller behind the trailing edge of the wing. The reduction gear is lubricated by oil from the engine pressure system.

The engine is mounted directly on the main wing spars on four rubber supports. It may be easily removed as a unit by taking off the cowling and unfastening the four bolts and the gasoline line. The radiator is carried on brackets attached to the engine. Cooling has been found satisfactory both in the air and on the ground. Interesting feature is that the basic engine may be traded in for a new one on the Ford plan for about $50.

Mr. Campbell reports that the ship takes off in about 350 to 375 ft., climbs at about 580 ft. per min., cruises at about 100 m.p.h., and has a top speed of close to 120 m.p.h. It is reported to have no spinning tendency, and to be very easy to land. Landing speed is reported at about 45 m.p.h.



Model 24 Fairchild on Edo floats.

Fairchild Seaplane

Model 24 tested on Edo floats for approved type certificate

As A RESULT of test flights by Dick Hansen, test pilot of Fairchild Aircraft Corporation, a Model 24 Fairchild mounted on Edo floats was granted a seaplane ATC. The ship was a 1935

BENDIX

AIRPLANE WHEELS · BRAKES · PILOT SEATS AND PNEUDRAULIC SHOCK STRUTS

AIRPLANE PRODUCTS

BRAKE WHEELS
High and Low Pressure "Streamline"

★

TAIL WHEELS
Low Pressure "Streamline"

★

AXLES
For All Wheels

★

BRAKES
Mechanically and Hydraulically Operated

★

OPERATING CYLINDERS FOR HYDRAULIC BRAKES
with Flexible Hose and Fittings

★

TAIL WHEEL KNUCKLES
For "Streamline" Wheels
Steerable and Swivelable
with Shimmy Dampener

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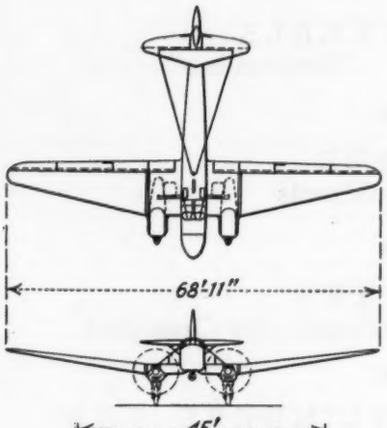
BENDIX PRODUCTS CORPORATION
AIRPLANE WHEEL AND BRAKE DIVISION • SOUTH BEND, INDIANA
(Subsidiary of Bendix Aviation Corporation)

model, powered with a Warner engine and fitted with standard flaps. Floats were Edo's Model 44-2425. Licensed gross weight was 2,500 lb. which, with a normal empty weight of 1,703 lb., gives a useful load of 847 lb. For the ship fitted with a wooden propeller, the useful load allowance will include three people, 40 gal. of gasoline, and 97 lb. of baggage and/or extra installed equipment. With a Hamilton Standard metal propeller, three people, 40 gal. of gasoline and 64 lb. of baggage and/or extra equipment may be carried. Full load take-offs were made in a 4-5 m.p.h. wind in 20 seconds. Under the same conditions lighter loads were taken off in 7 to 9 seconds. Top speed at sea level was about 120 m.p.h. at 2,150 r.p.m.

With Foreign Builders

The trend toward two-engine monoplanes both for military and commercial purposes continues

PROBABLY the fastest of Britain's two-engined low-wing monoplane bombers is the Bristol 142 recently described in these columns. Latest edition of this type is the Avro Anson designed primarily for long-range reconnaissance, shown in an accompanying drawing.

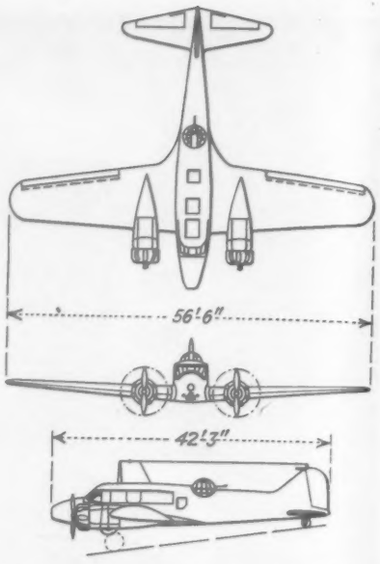


Focke-Wulf FW-58 as a navigation and blind flight trainer.

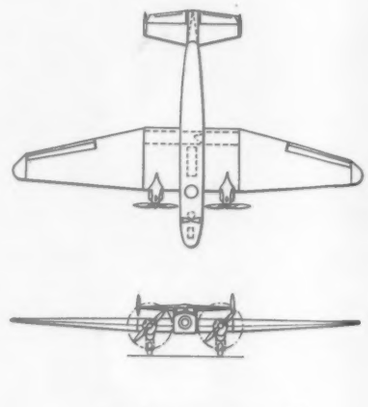
Its engines are Siddeley Cheetah IX motors, supercharged to 310 hp. each at 2,100 r.p.m. at 6,000 ft. and to a maximum of 350 hp. at 7,300 ft. Top speed is 188 m.p.h., range 760 miles. Normal crew, three—pilot, navigator-bomber, and radio-gunner. Construction is mixed, with wood-framed plywood-covered wings and steel tube fabric covered fuselage.

Of the same general type, but somewhat larger, is the French Caudron-Renault R-570. It is designed for a bomber, transport, cargo carrier or ambulance ship. Normal crew consists of pilot, navigator-bomber, and radio operator, all of whom sit well forward in the fuselage. Engines are eighteen-cylinder water-cooled Renaults of the W type rated at 700 hp. (normal). Top speed is said to be over 200 m.p.h., cruising at 170. Construction is composite, with semi-monocoque center section both of wing and fuselage. After portion of the fuselage is of steel tubing. Outboard wing panels and tail unit are of wood with stressed plywood covering. Control surfaces are all duralumin framed, fabric covered. Vertical tail surfaces are of the divided fin type, somewhat similar to our own Lockhead Electra.

Germany has gone in for the monoplane twin engine type in a big way,

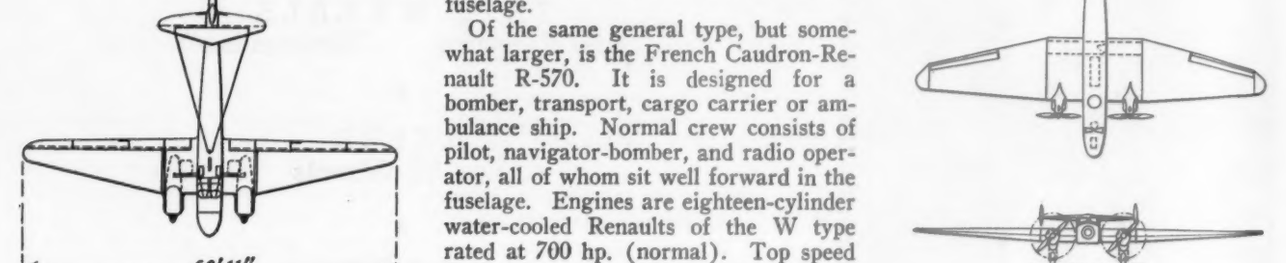


The Avro Anson (British) for long-range patrol.



The French Caudron-Renault R-570.

both for military and commercial models. A machine now used extensively in the German Air Corps is the Dornier bomber, Do-23, a high-wing semi-cantilever monoplane with twin en-



Focke-Wulf FW-58 as a training bomber.

Junkers JU-86 commercial transport.

Heinkel He-111 transport.

gines and a fixed landing gear. The wing is similar to the older DoF type with dural spars and dural ribs, fabric covered. Fuselage is a metal monocoque with smooth skin flat sides and rounded corners. Power plants are two B.M.W. liquid cooled engines of 750 hp. each. The Do-23 has an empty weight of 12,400 lb., gross weight 19,240 lb. Top speed is reported as 161.5 m.p.h. Range is 745 miles, ceiling about 19,000 ft.

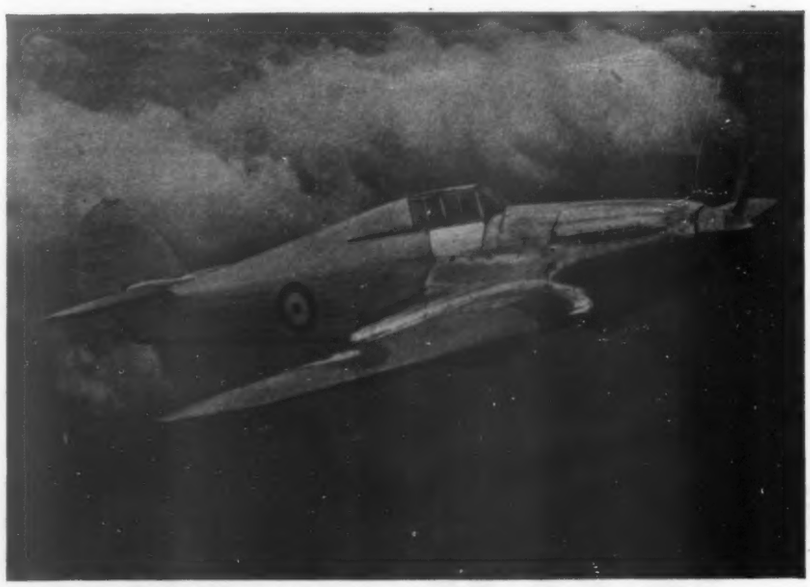
Designed primarily as a bombing trainer, is the latest Focke-Wulf FW-58 Weihe. The machine is available in two forms, one for general flight and blind flight training with closed cabin only (see drawing), and the other as a bomber and machine-gun training ship with two open cockpits and bomb positions as well as the closed pilot cabin (shown in photograph). Power plants are two inverted air-cooled V-type Argus As-10Cs developing 240 hp. each. They have very small frontal areas, and fair very well into the leading edge of the wing stubs. Empty (as a closed cabin trainer) the ship weighs 4,170 lb. Its gross weight is 6,170 lb. Top speed is reported at 158 m.p.h.

On the commercial side, one of the latest ships to be seen on Lufthansa is the two-engined high-speed transport Junkers JU-86. This ship has a capacity of ten passengers and their baggage. It is a development of the well-known JU-52 but differs in that the fuselage is oval in cross-section and the skin is smooth. Landing gear retracts into the engine nacelles. The Junkers double wing design is used, with a narrow airfoil running along the trailing edge of the main wing, forming both flaps and ailerons. Power plants are either 644 hp. B.M.W. Hornets or 500-560 hp. Junkers Jumo diesels. With the two air-cooled engines, the top speed is in the neighborhood of 223 m.p.h., cruising 211 m.p.h.

Heinkel's latest commercial airplane is the He-111 derived from the high performance He-70 single-engine four-passenger monoplane of several years ago. The new ship is the first all-metal design turned out by Heinkel. Previous models have been of composite construction. Fuselage is a monocoque type. Wings and fuselage have light metal framing, are covered with sheet dural. Tail surfaces are also of metal. Trimming tabs are fitted to the elevators for horizontal trim, and wing flaps reduce landing speed.

A baggage compartment is provided ahead of the pilot's cockpit. The main cabin is divided into two compartments with a total of 10 seats; 440 lb. of mail and cargo may be accommodated beside the passengers.

Engines are 660 hp. B.M.W. twelve-cylinder, water-cooled V-type, driving



Hawker fighter (British) powered with Rolls-Royce Merlin engine.

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ONLY A FINE PRODUCT MAY JAR BEAR THE NAME ROEBLING

three-bladed Hamilton Standard propellers. The ship is stressed for future mounting of two 880 hp. engines. General dimensions are: span 74.1 ft.; length 56.1 ft.; weight empty 11,440 lb.; gross weight 16,750 lb. Performance, top speed 214 m.p.h.; cruising speed 186 m.p.h.; normal range 930 miles. With the higher powered engines the ship is expected to attain a top speed of 254 m.p.h.

Although the two-engined ship definitely dominates the overseas horizon at the moment, a number of high-performance, single seaters are worthy of comment.

One of the latest experimental ships delivered to England's Royal Air Force is the single seater Hawker. This low-wing cantilever, retractable landing gear monoplane is a distinct departure for British fighting ships. Reports indicate that it has a top speed of 320-325 m.p.h. The ship is fitted with the new Rolls-Royce Merlin engine, a twelve-cylinder liquid-cooled V-type, with the so-called "ramp head" shape combustion chamber. This construction permits much higher compression ratios and therefore higher output for relatively small overall dimensions. Present rating of the Merlin is 950 hp. at 11,000 ft. and 1,000 hp. at 1,500 ft. The dry weight of the engine is about 1,200 lb. and its maximum overall dimensions are: width 26.2 in.; height 38.4 in.; length (including wood propeller hub) 78 in. For high-speed aircraft (of the order of 300 m.p.h.) the frontal area of a glycol radiator is 2-2.5 square feet. The same engine is being fitted in experimental pursuit machines being developed by Supermarine, Westland, Boulton & Paul, and Fairey (see picture below).

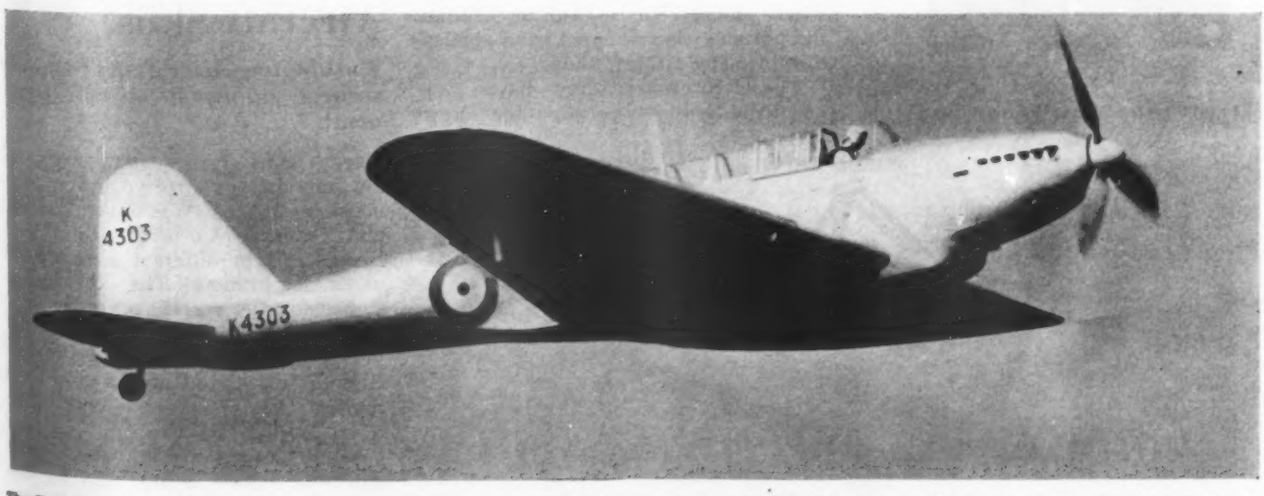
Mentioning engines in passing, another interesting type is the new Armstrong Siddeley Mastiff, a fourteen-cylinder, double-row radial, rated at 1,000 hp. at 15,000 ft. It weighs 1,540 lb. and has an overall diameter of 53 in. Reports indicate that the same concern is developing a three-row 21-cylinder air-cooled radial, not exceeding 50 in. in diameter and intended to produce 1,500 hp.

Fokker CX fighters for the Netherlands.

Fokker's latest experimental fighter, the D-21.

From Holland come reports of recent Fokker activities. One of our illustrations shows a number of Fokker CX two-seat reconnaissance machines fitted with Rolls-Royce Kestrel engines. Performance figures are not available. It is understood that a large number of this type are being built by the Fokker works in Amsterdam for the Dutch Army Air Service and for the Dutch East Indies.

A radical departure for Fokker is the latest single-seat fighter, the D-21. This machine is a low-wing monoplane powered with a radial engine and fitted with fully enclosed cockpit. Landing gear is of the fixed type. Power plant is a Bristol Mercury VI which gives it a top speed of about 250 m.p.h. An alternate power plant is the Hispano-Suiza type Ycrs engine which is expected to yield a top speed of some 280 m.p.h.



The Fairey Battle, England's latest raider fitted with the 1,000 hp. Rolls Royce Merlin. Construction—all metal. Performance—unknown, but top speed admitted over 250 m.p.h.

Buyers' Log Book

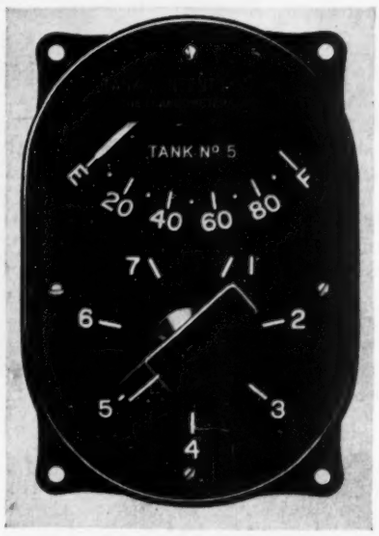
What's New in Accessories, Materials, Supplies, and Equipment

Fuel Tank Gage

Liquidometer announces selector type gage for aircraft tanks

A NEW electric instrument by the Liquidometer Corporation (Skillman Ave. at 37th St., Long Island City, New York) consists of a combination selector switch and automatic dial change unit. When used with a tank contents gage on aircraft mounting a number of tanks of different size, the instrument provides a separate dial graduation reading in gallons for each tank. When the switch is turned to a given tank number, the dial graduated to conform with that particular tank comes into view in a window in the top of the unit. Optional attachment provides a low level warning signal with the fuel selector valve. Low level warning signals are also available as separate units.

Gages of this type are also applicable for remote indication of position of other moving parts of an airplane such as flaps, retracting landing gear, etc.



Liquidometer Tank Content Gage

Strainer at Intake

DeVilbiss Company develops fluid strainer for spray gun mounting

THE NEW Type VS fluid strainer is designed to attach directly to the inlet of the Type MBC spray gun. Principal advantage is that the strainer takes out impurities just before passing into the gun and eliminates any pick-up from hose and piping. Strainer consists of a screen reinforced with a coil spring enclosed in a metal tube. Fluid flow is from outside to inside the screen. The latter is easily removable for cleaning. The strainer is connected to the fluid inlet of the spray gun. It is braced by means of a metal arm to the gun handle.

New DeVilbiss Spray Gun Strainer

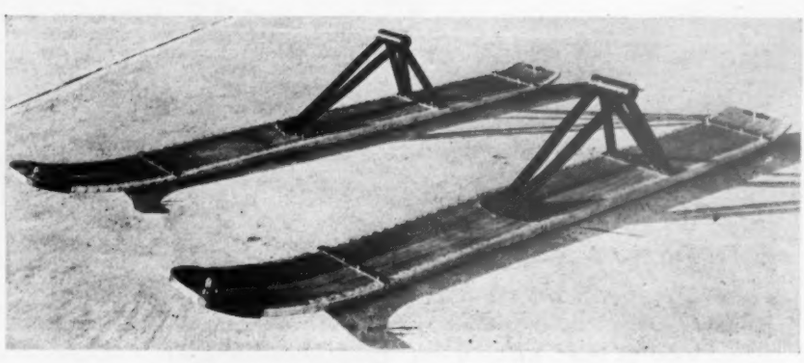
New Thor Tools

Two new items announced by Independent Pneumatic Tool Co.

Two new items have recently been added to the Thor line (Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill.). Both of them are the portable electric type, have application to many aircraft shops.

The U-16 electric screw driver gives one hand driving operation for screws ranging from No. 4 to No. 12. All weight is concentrated at the operator's hand making for a well balanced tool. The machine is 10½ in. overall length, weighs complete 3½ lb. It is equipped with a slip clutch attachment. Screw sizes are changed by simply changing the finder and bit.

A new heat gun (Model U-26), has been designed to furnish an airblast of 400 deg. F. for thawing-out frozen grease, warming up stiff crankcase oil, drying electrical systems, spark plugs, etc. Equipped with an 850 watt heating unit. Four types of nozzle are furnished as standard equipment for various applications.



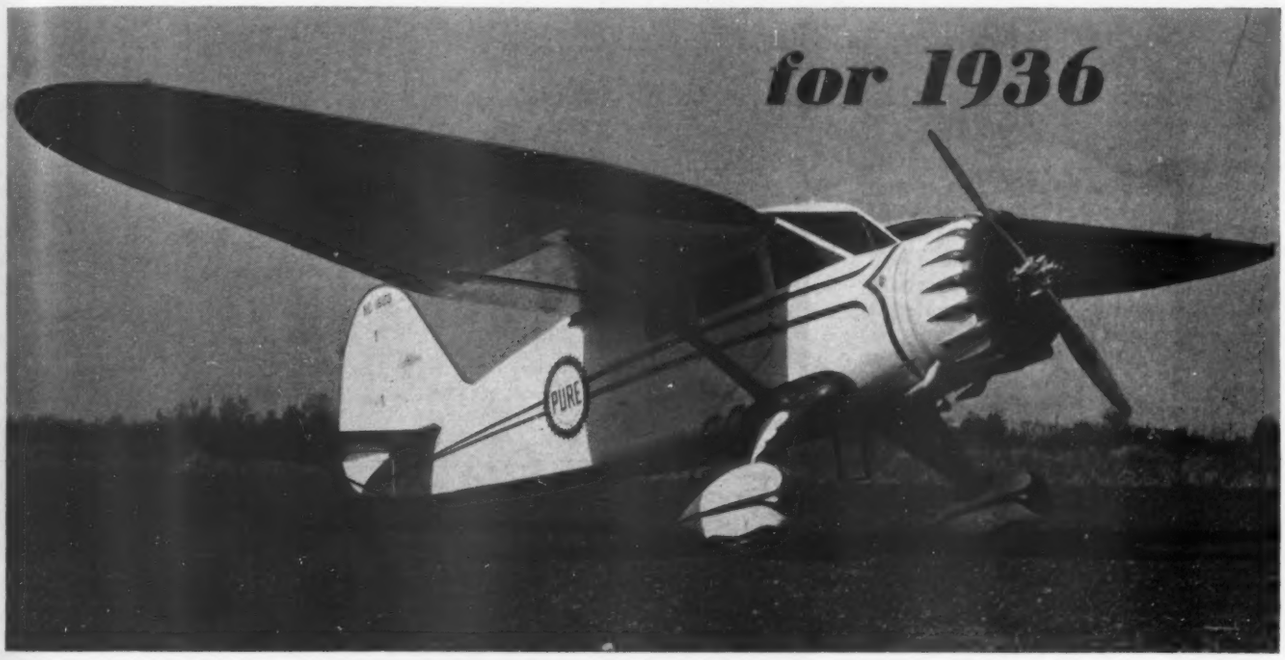
New Ski Equipment by Washington Aircraft & Transport Corp.

Aircraft Skiis

Washington Aircraft & Transport secures approval on ski equipment

DEPARTMENT OF COMMERCE approval on four sizes of airplane skiis was announced by the Washington Aircraft and Transport Corp. at Boeing Field, Seattle. Eight different sizes are now under development. The skiis were designed to meet specific operating conditions in Alaska by A. Elliott Merrill, president, and N. C. Showalter, Jr., chief engineer. Pedestals are of welded steel tubing. Oak or spruce is optional material for the ski. Plain or sheet metal covered bottoms are optional. Present approved models include skiis for ships of 2,600, 3,600, 4,600, and 5,600 lb. gross weight.

Announcing a New Series of
HIGHER POWERED "RELIANTS"



Model SR-7C Built for the Pure Oil Company of Chicago

MODEL SR-7C
260 H.P. Motor and Controllable Propeller.

MODEL SR-8D
285 H.P. Motor and Controllable Propeller.

MODEL SR-8E
320 H.P. Motor and Controllable Propeller.

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Prices and other specifications on request.

Business Accepts Stinson

More business concerns now fly the Stinson "Reliant" than all other makes of modern four place cabin planes combined. This acceptance has been accorded the "Reliant" due to a super-dependability made possible by the fineness of manufacture of a design of such basic soundness that it permitted constant improvement without obsoleting changes.

The standard SR-7B "Reliant" carries more useful load and gives better all around performance than any of its predecessors but to accommodate those who desire to carry greater loads at high altitudes, Stinson now presents this new series of higher powered "Reliants." These planes are stressed to carry greater loads at higher speeds and, of course, maintain those safety factors which continue to be synonymous with the name "Reliant."

Stinson Aircraft Corporation

Division of Aviation Manufacturing Corp.

WAYNE MICHIGAN U.S.A.

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L. A. P. E. (Spain)
LOT (Poland)
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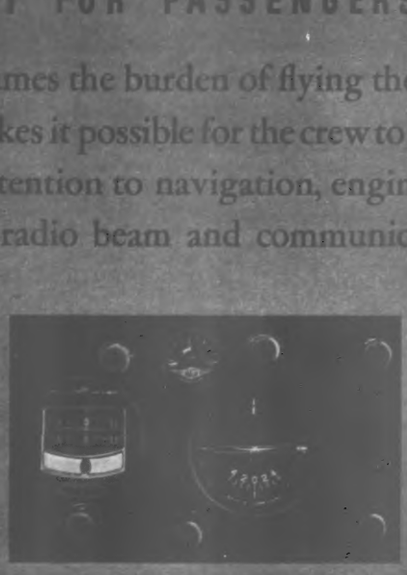
Provides
SMOOTH, AUTOMATICALLY CONTROLLED FLIGHT FOR PASSENGERS....

... assumes the burden of flying the plane and makes it possible for the crew to devote their attention to navigation, engineering duties, radio beam and communications.



SPERRY GYROSCOPE CO. Inc. *Manhattan Bridge Plaza* BROOKLYN, N.Y.

Operator's Corner

An exchange of ideas on the problems of the commercial aviation industry

QUESTION 14: What do you think of the present regulations for medical examinations for flight students? Do they discourage students from getting started because of the expenditure of time or money involved. Would there be any great risk in amending them to defer the examination until the student had several hours of dual? Should the number of medical examiners be increased or should the examination privilege be extended to other physicans? Should the Air Commerce Bureau permit operators to charge for the flight demonstration time up to one hour that is now allowed only if given free?

Unnecessary sales resistance

THIS subject has long been a sore spot with every small school operator in the country. The company which I represent is primarily a sales organization and I must say that if the Department of Commerce threw a piece of sales resistance into the path of our airplane selling as they do in the sale of student courses by the application of the medical examination requirement, this company could scarcely exist.

The examination in itself is all right and I have no great quarrel with the amount of fee involved, though it is my personal opinion that it is just about twice as much as it should be. The ridiculous thing about it, however, is the requirement which makes the student have the examination before he ever takes a flight. There is absolutely no question but what this examination should be moved up to the point where the student would not be permitted to solo until he has had his physical examination. This would unquestionably mean an increase of from 10 per cent to 40 per cent in the business of the small unapproved school operator.

We have given some 2,000 hours of instruction in the past three years. In that time we have had a pretty good cross-section of the people who learned to fly and in absolutely none of these cases have we found any single instance where the physical examination meant anything at all from a safety standpoint.

It is this writer's very firm belief that a change in the requirement making it necessary for the student to get his license only before soloing would be a great boon to operators in general.

I would also like to go so far as to state that this company will cooperate in any manner possible to secure the repeal of what we consider an absolutely ridiculous requirement.

In closing may I again state that if your magazine should take the initiative to have this requirement changed it would be doing a material service to every small operator in the United States.—WINSTON W. KRATZ, *President, St. Louis Flying Service, Inc., Lambert Field, St. Louis, Mo.*

Examination before landings

THERE is no doubt that most prospective students approach the matter of flight instruction with considerable hesitation. The least obstacle in their path is frequently sufficient to deter them completely from going ahead. Any step to ease their entry into flying and make it appear simple will help the business.

It is our opinion that most instruction accidents where students without permits are involved have come late in the course and from parties who would have evaded the regulations however they were formed. If this is the case, the present requirement is not affording the safeguard it was intended. Perhaps if the regulations were eased, there would be more general compliance.

If an instructor is worthy of his transport license, he should also be able to judge a person's aptitude for normal *airwork* behind the controls. There have been a number of prospects we have not cared to place in a separate cockpit for their first try, though in a side-by-side ship we have not been concerned.

We therefore suggest that the present regulation be amended to the extent that no *landing instruction* be allowed until the student permit is secured. This will facilitate gaining a prospect's permanent interest, will not increase the danger, and will automatically take care of the problem of charging for demonstration time. This plan also allows time enough for a prospect to determine his desires but protects him for making a large cash outlay before learning that he may be physically disqualified for solo flying.

In our section of the country there appears no need to have more medical examiners.—F. T. KURT, *Viking Flying Boat Company, New Haven, Conn.*

Examination at solo

SINCE the pilot or operator of a plane is held responsible for what may happen in giving instruction I cannot see the necessity of medical examination during the period of dual instruction. It has been my experience that such expenditure of time and money involved in securing the student permit is discouraging both to prospective students and owners. Since the pilot who gives dual instruction holds a transport license and uses equipment representing a considerable investment, his judgment should be sufficient regarding such students as he would care to instruct. Another possibility is that the Department of Commerce designate those instructors meeting Department qualifications and permit them to give dual instruction without student permits. I cannot see that there would be any reason for the examination until approximately the time of solo. I would not recommend that solo flight be allowed without the permit obtained through medical examination. A plan whereby the prospective student could bring a medical permit from his family physician would be sufficient until he is ready to solo. I can see no advantage in increasing the number of examining physicians unless it would be in a territory not now being served.

The operator should be privileged to charge for demonstration flights which are now permitted to be given free. In view of the fact that only a small per cent of the students who start training ever complete the course it is a waste of money for the examination when the student knows so little about flying and is not in a position to judge how far he will go. I have also found that insurance companies either cancel insurance or increase rates when a student permit is obtained.—H. G. MAYES, *Manager, Huntington-Chesapeake Airport, Huntington, W. Va.*

Question 15

(Answers will be published in May)

DO YOU give free instruction to plane purchasers? If so, do you give them any further instruction beyond solo? Do you charge for demonstration time given in selling airplanes? In the sale of planes for executive or business service, do you give the prospect an opportunity to use the ship on trial?

Question 16

(Answers will be published in June)

WHAT is your method of estimating fares for taxi service? Do you base the charge on a straight mileage basis or on other factors? Do you charge an extra premium for night flying or flying under unusual conditions? Have you found your charges agreeable to customers?

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Wright Engines power the latest types of military aircraft of the U. S. Army Air Corps, the U. S. Navy and Marine Corps, and the fastest transports on leading airlines throughout the world.

Wright builds 39 direct drive and geared models of aircraft engines—a type for every private, commercial and military requirement. Wright Whirlwinds range from 235 to 450 horsepower; Curtiss Conquerors range from 655 to 700 horsepower; Wright Cyclones range from 700 to 1000 horsepower.

The new 1000 horsepower Wright Cyclone is the world's first 1000 h.p. radial, air-cooled engine in service operation. Engines of this type will power all of the new Douglas and Boeing Bombers recently ordered by the U. S. Army Air Corps, as well as the new Douglas Super Transports.

The remarkably low fuel consumption of the 1000 horsepower Wright Cyclone supplements the low maintenance costs and proven reliability of this type of engine —established by many years of military and naval service and by 100,000,000 miles of airline operating experience. "Powered By Wright" is your assurance of dependable, economical engine performance.

A few of the many military, commercial and sport planes "Powered By Wright" are illustrated in this advertisement.

Waco Cabin Biplane Powered by a 350 h. p. Whirlwind.

Lockheed Electra Transport Powered by Two 450 h. p. Whirlwinds.

North American Advanced Trainer Powered by a 400 h. p. Whirlwind.

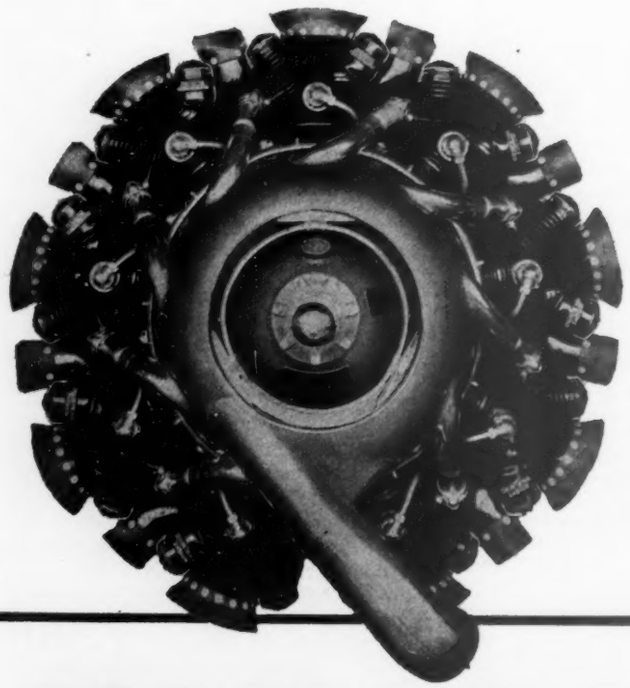
Beechcraft Cabin Biplane Powered by a 450 h. p. Whirlwind.

Curtiss-Wright Advanced Trainer Powered by a 350 h. p. Whirlwind.

Fairchild Cabin Monoplane Powered by a 350 h. p. Whirlwind.

Noorduyn Norseman Cargo Plane Powered by a 450 h. p. Whirlwind.

Bellanca Pacemaker Powered by a 450 h. p. Whirlwind.



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WHIRLWIND

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COMMERCIAL *and* MILITARY AIRCRAFT

Curtiss BF2C-1 Navy Fighter Powered by a 750 h. p. Cyclone.

Martin B-10 Army Bomber Powered by Two 750 h. p. Cyclones.

Douglas Super Transport Powered by Two 1000 h. p. Wright Cyclones. Cyclones also power the new Douglas U. S. Army Bombers, the world famous Douglas DC-2 Transports and the new Douglas Commercial Amphibian Flying Boats.

Consolidated Navy Patrol Boat Powered by Two 700 h. p. Cyclones.

Grumman Coast Guard Amphibian Powered by a 750 h. p. Cyclone.

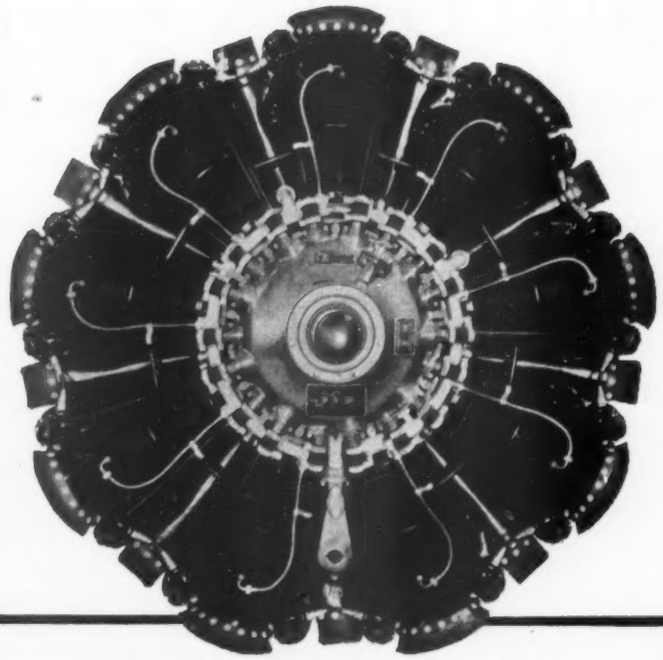
Boeing 4-Engine Bomber Powered by Four 1000 h. p. Cyclones.

Northrop Attack Powered by a 750 h. p. Cyclone.

Vultee Attack Bomber Powered by a 750 h. p. Cyclone.

Sikorsky Amphibian Powered by a 750 h. p. Cyclone.

K. L. M. Fokker F-36 Powered by Four 750 h. p. Cyclones.



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NEW YORK CITY, U. S. A., CABLE "AEROEXCO"

CYCLONE

PIONEER INSTRUMENTS

AUTOSYN REMOTE INDICATING SYSTEM

The Pioneer Autosyn System provides a positive means of remote instrument indication employing a proven principle. A small transmitting unit, located at the source of measurement, transmits to an indicating unit on the instrument board the movement of mechanisms such as Bourdon tubes, diaphragms and position indicators. By using a dual indicator with two pointers, as many as four functions for each of two engines may be shown on one dial.

The Pioneer Autosyn offers the following advantages:

Eliminates long tubing and shafts • Eliminates fuel and oil lines to the cockpit • Conserves instrument board space • Simplifies servicing, as the only connection between the transmitting and indicating unit is an electric conductor • Eliminates instrument failure due to broken or plugged capillaries or other tubes • Adaptable to all instrument indication.

The complete Pioneer line includes instruments suitable for every type plane and every kind of flying.

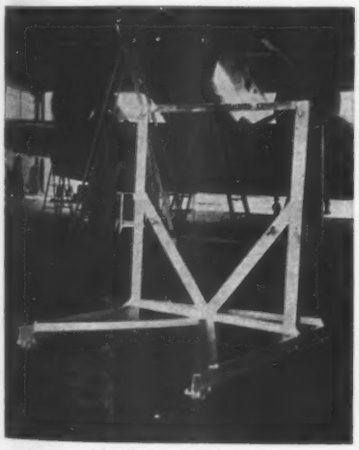
PIONEER INSTRUMENT COMPANY, INCORPORATED

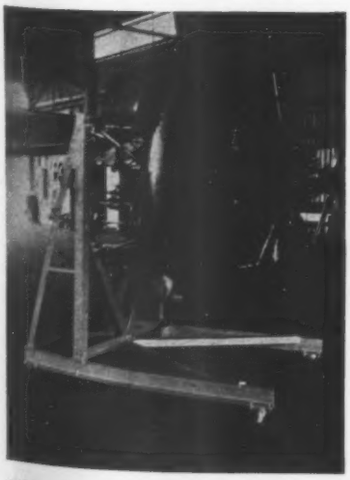
BROOKLYN • NEW YORK • A SUBSIDIARY OF THE BENDIX AVIATION CORPORATION

The Maintenance Notebook

Assembly Stand

A GREAT deal of time is saved in installing Wright Cyclones in Douglas Transports at Eastern Air Line's Miami base by the use of steel-framed jigs on which everything ahead of the fire wall may be fitted up before swinging the engine into place in the ship. Everything may be completed down to the plumbing, electrical and control connections. All of the baffling and most of the cowling may be put together while the power plant is still on the floor. Stands are welded up out of ordinary structural angles and channels. Four attachment fittings are provided, corresponding to the nacelle mountings. Full swivelling casters make it easy to move the stands into storage areas, or under the nacelles to receive or to deliver an engine. The same type of assembly stand is now being used by TWA and other users of Douglas equipment.





The use of a nacelle assembly jig saves time in making engine changes in Eastern Air Lines' shops.

Fireproof Suit

WANDERING about Pan American's Dinner Key base, one is apt to be somewhat startled by a ghost-like object encased in a glazed cabinet against a hangar wall just inside the door. No skeleton in Pan American's closet this, but a complete suit of asbestos clothing for emergency use in case of fire. Helmet, coat, trousers, gloves and boots of heavy fire-resistant material may be quickly donned to permit close approach to fires in any part of the hangar or about aircraft. Protection of this sort is useful not only to permit men to get in close to the center of a fire to use chemical or other kinds of extinguishers, but, in cases where the fire may occur on aircraft standing in hangars, it makes it possible for crews to enter and rig towing lines so that the machines may be dragged out into the open and will not jeopardize the building or its contents. The equipment is similar to that used aboard the Navy's aircraft carriers, although in that case the primary purpose is to aid in rescue work following crash and fires on deck. So far there has been no occasion to use the suits at Dinner Key, but they stand ready for instant use in any emergency. (See also page 16.)

Not the skeleton in the closet, but an asbestos suit for emergency fire fighting at Pan American's Dinner Key base.

Load Carrier

AT Eastern Air Line's new base (36th Street Airport, Miami), the engine shop and ship servicing are in separate buildings making the handling of engines or other heavy parts back and forth difficult without auxiliary means. The problem was licked, however, by the underslung trailer shown in the accompanying cut. Ford automobile wheels were used.

The overall dimensions of the flat bed have been made to accommodate the castor-mounted radial engine assembly stands commonly used in most motor overhaul shops. The main axle and framing were made out of light I beams with angle-iron reinforcement. The floor of the trailer is very close to the ground and when the outfit is disconnected from the tractor the rear edge may be tipped down to ground level, making it easy to push engines and assembly stands or other heavy parts on board. A bar inserted across the frame as shown, prevents material sliding off. Since the load is carried at or near the center of gravity of the trailer it is an easy matter to depress the towing yoke to connect up with the drawbar of the tractor. With the large diameter, pneumatic-tired wheels all around, loads can be handled at reasonably high speeds even over fairly rough ground.

This simple trailer with its large pneumatic-tired wheels finds many uses around Eastern Air Lines' Miami base.

GREATER SPEED–MORE ROOM–MORE COMFORT

THE new Sikorsky S-43 Amphibions recently placed in operation by Inter-Island Airways of Hawaii have greatly augmented the demands for this service. Greater speeds have shortened schedules. Larger, more luxurious cabins have increased available passenger accommodations. Superlative riding qualities have added to the comfort of the air traveler.

A new era unfolds in Hawaiian air travel.

SIKORSKY AIRCRAFT

BRIDGEPORT, CONNECTICUT

DIVISION OF UNITED AIRCRAFT MANUFACTURING CORPORATION

News of the Month

Airplanes only means of communication during floods . . . Five airlines combine to build new plane . . . American asks rate revise . . . Chicago & Southern buys Lockheeds . . . TWA installs fuel-air ratio analyzers, gets rehearing on San Francisco spur . . . Varney moves base . . . Army asks new bids, awards engine contracts . . . French confer on North Atlantic line . . . German Zeppelin flies to Brazil . . . Air mail base stays in Newark . . . Year-end financial reports of many companies.

Deluge

Aircraft offer first method of communication and relief in flooded districts of New England and Pennsylvania

RISING flood waters in wide areas in the northeastern part of the United States in mid-March would have written a much higher toll of death and destruction had it not been for the airplane. With rail and highway communications completely cut off, with telephone and telegraph wires down, and with failure of power plants shutting down most of the normal radio communication, the airplane remained as the single agency of relief for many an isolated community. Airlines, flying services, Coast Guard, private owners struggled valiantly to alleviate conditions, turned in a brilliant record of service in the emergency.

For several days TWA was the only means of communication between Pittsburgh and New York. Six hundred and eighty-nine passengers were carried into Pittsburgh and 276 out during the week of the flood. All available equipment and personnel were concentrated in the eastern regions. In addition to the seven regular schedules ordinarily operated, eight extra schedules were flown with passenger ships and many other schedules flown with two cargo planes pressed into service for carrying supplies. Between March 18 and March 22, the line handled 29,600 lb. of medical and emergency supplies into the Pittsburgh area.

Pennsylvania and Central were hampered in their operations at Washington by the fact that the Hoover Airport was under water. Along with Eastern Airlines, and other users of the Washington terminus, operations were conducted from Baltimore during the flooded period.

Pennsylvania Air Lines put on many extra schedules on an emergency basis, and operated almost every hour out of Pittsburgh. It transported relief supplies free of charge for the Red Cross, handling some 21,000 lb. of cargo during the week.

Central Air Lines pressed every piece of available equipment into service. When failure of power at Allegheny Airport cut off the boundary and other lights, landings were made by means of smudge pots and lanterns.

American Airlines reported large increase in traffic during the flood. Extra schedules were put on many routes and long waiting lists were the rule. Many relief workers were transported.

Typical cargoes consisted of emergency tools and supplies, serums, medicines, disinfectants, food, yeast and drinking water. Large quantities of first-class mail were handled, and at times even telegrams were sent into flooded districts by airplane.

Flying service operators rendered

Wide World

CEILING MINUS

as 20 ft. of flood waters encroach on Brainard Field, Hartford, Conn.

supplementary aid to the airlines—flying and landing planes under extra hazardous conditions. Typical is a statement sent in by R. S. Hart, manager of Air Service, Inc., at Johnstown, Pa., who said, "During Wednesday, the day after the flood, several ships with Red Cross workers, state police officials and newspapermen arrived. Toward the middle of the afternoon, when word was received that the Quemahoning Dam, the largest in this section, was broken, J. J. Kostura made three trips from here to the dam through practically zero-zero conditions, to check on these reports, which were false. Thursday afternoon I made several flights from the Penn-Harris airport to the Harrisburg airport with food for about 125 refugees who were isolated there."

The U. S. Coast Guard was active in rescue work. Grumman and Douglas amphibians from Atlantic Coast stations flew far inland on many relief missions. Army and Navy planes and pilots were assigned to flooded areas. They carried food, serums, and supplies into areas that could not be reached on the ground.

Only two aircraft manufacturing units were located in flooded districts, the United Aircraft Corporation's unit at East Hartford and the Lycoming Division of Aviation Manufacturing Corporation at Williamsport, Pa. Fortunately neither one of these plants was situated below high water level, and the damage was confined to loss of time due to shutdowns occasioned by lack of power and by inability of employees to get to work.

Transport Notes

American wants more pay. New schedules for Braniff, Northwest. Chicago & Southern buys Electras.

AMERICAN AIRLINES filed a petition with the I.C.C. March 10 asking for revision of rates of pay for carrying mail on Dallas-Los Angeles, Boston-Newark, Boston-Cleveland, Cleveland-Nashville, Newark-Fort Worth, and Chicago-Fort Worth routes. The line claims to have lost $758,000 in a single year of operation, says it is unable to obtain loans or pay for equipment ordered without more airmail income. Other American news last month: (1) To save drain on planes' storage batteries, plug-in telephones have been installed for last-minute communication between pilots and dispatchers before taking off. (2) With the return of vacation weather, a plan of circle air tours has been inaugurated.

On March 7, the Bureau of Air Commerce issued a report of the investigation into the crash of an American Airlines plane on Jan. 14, near Goodwin, Ark. The condition of the wreckage was such that very little direct evidence as to the cause was discoverable. After listing several possible causes including *(a)* structural failure of the controls or control surfaces; *(b)* passenger interference; *(c)* erroneous instruments; *(d)* passenger being showed pilot's compartment, with lights turned on; *(e)* one fuel tank running dry; and *(f)* co-pilot alone at controls, the report winds up with the statement that "although flying at low altitude may have contributed to the cause of this accident, the probable cause or causes thereof cannot be determined."

Braniff Airways will speed up schedules with all-Electra service making better contacts with transcontinental systems.

Edward G. Bern, president of Columbia Airlines, has announced reorganization of the company. Harry McGee, former chief pilot, has been named operations manager.

Superseding its old fleet of tri-motors, Chicago & Southern has bought four new Lockheed Electras. These will cut three hours from present schedules between Chicago and New Orleans.

TWA is installing fuel-air ratio analyzers in all its ships. These devices tell the pilot visually just when he is using the most efficient carburetor mixture, give indirectly a measure of power consumption.

In TWA's proposed plan to institute an off-line service from Albuquerque to San Francisco, the I.C.C. has ruled that it has jurisdiction over the Post Office Department to permit the service. The case has been reopened for consideration on its merits.

Calendar

May 15, June 1—International Aero Exhibition, Stockholm, Sweden.
June 20-July 5—Seventh Annual National Soaring Contest, Elmira, N. Y.
Sept. 3-6—National Air Races, Cleveland, Ohio.
Oct. 25—Paris-Saigon Air Race.

Fuel De-Icer

Stabilizer developed for compounding alcohol-gasoline blends

STABLE BLENDS of alcohol and aviation gasoline are claimed through the use of a new compound developed by C. C. Callis of Oakmont, Pa. Preliminary tests by the Bureau of Standards in conjunction with the Bureau of Air Commerce have indicated that the stabilized blends not only prevent ice formation in carburetors but also act to de-ice a carburetor once ice has begun to form.

The fuel consists of a blend of alcohol and gasoline, stable and operative at temperatures as low as —40 deg. F. The stabilizer is effective in the presence of many types of anti-knock compounds nor is the lead susceptibility of the basic fuel affected by it. There have been indications that the addition of the stabilizer raises the octane ratings of certain fuels.

It is claimed that the fuel can be applied to airplanes without the addition of any specialized equipment. The de-icing fuel may be carried in a separate small tank, or it may be made part of the 87 octane fuel which is used for take-off by many transport companies today.

Bids and Orders

Air Corps spends $5.6 million for engines, asks new bids on aircraft

NEW flying equipment for the Air Corps was indicated March 1 when bids were asked for bombers, observation planes, and pursuits. From 50 to 250 two-engined bombers (Specification 98-204) and from 5 to 75 multi-engined bombers (Specification 98-201-B) will be bought, bids for which will be opened Nov. 4. On Sept. 3 bids will be opened for up to 125 observation planes (Specification 98-408) and the following day for 175 single-seated pursuits (Specification 98-605).

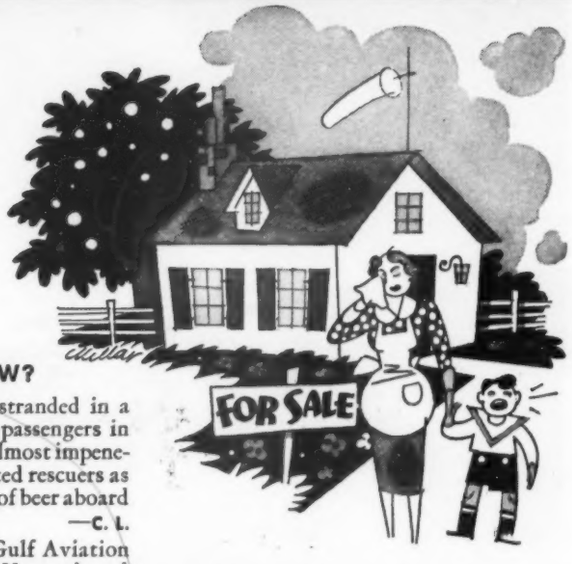
Changes in opening date for bids already asked have also been announced by the Materiel Division, Wright Field: For single-engined transport (cargo) ships (Circular Proposal 36-85) from July 30 to June 30, 1936, with the time set for acceptance changed from three to two months thereafter. Basic trainer openings (Circular Proposal 36-468) scheduled for Nov. 17 have been moved up to Aug. 17, for passenger transports (Circular Proposal 36-320) from Sept. 10 to July 10.

To Wright on March 11 went an order for 512 engines, at a cost of about $3,850,000. Of these, 432 ($3,544,000) are new G Cyclones rated at 1,000 hp. for take-off. The 82 twin-engined bombers now building at the Douglas plant in Santa Monica will use 328 of them, the other 104 being used for Boeing's thirteen four-engined bombers. (In this, as in other orders detailed below, 100 per cent spares are included.) The remaining 80 are 450 hp. Whirlwinds for use in the 40 basic trainers being built by North American.

A Pratt & Whitney order, let March 31, was for 200 fourteen-cylinder Twin Wasp Jrs., rated at 750 hp. They will cost $1,877,030. They will be used in the 100 single-engine attack ships being built by Northrop.

Good news for manufacturers trying to make a year-in-year-out profit in the face of high development costs not otherwise provided for, came late in March. The Senate struck from the

The Birdmen's Perch



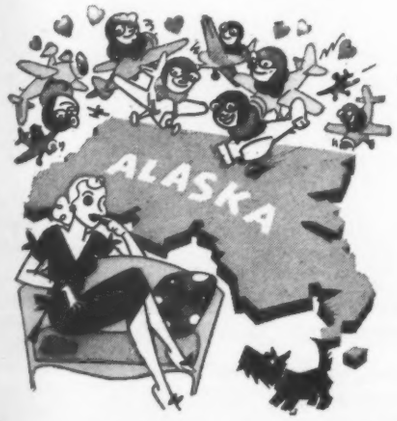
Please don't shush up. Keep up the bombardment of yarns, gossip and whoppin' big fibs that make this page so much fun. Send all contributions and criticism to

MAJOR AL WILLIAMS, *Manager, Aviation Department*
Gulf Building, Pittsburgh, Pa.

MAIDEN HUNGRY FOR LETTERS FROM ALASKAN PILOTS

"Congratulations! Your 'Birdmen's Perch' is great. But you say bird-*men* and air-*men* and I don't know if we girls can have our say or not. You know we play an important part in this fascinating industry, and will play an even more important part in the future. Wait and see!

"Right now I am all revved up to correspond with a pilot in Alaska, but as I know no one there, of course I do not know who to write to or if they would



care to write to me. So will you print this next month?

WANTED: Correspondence with a pilot who is now engaged in flying activities in Alaska. Please send name and address to this page in answer to B.T.'s request.

"You may do as you please about putting the Miss on that request. After all, there are only 56 pilots in Alaska, and if they all decided to write—you know!"

—MISS B. T.

APOLOGY

Central Airlines writes: "We wish to acknowledge the very fine Aviation Atlas recently sent us by your company. We are somewhat at a loss, however, to understand why the Model "A" Stinson was not shown on page 5, inasmuch as we believe this is the fastest 3-engine commercial airplane in the world."

"Correct," says Gulf, "and we're sorry!"

DID YOU KNOW?

"That it *can* be fun to be stranded in a Brazilian swamp. Recently passengers in a plane forced to land in an almost impenetrable morass, merrily awaited rescuers as they drank up case after case of beer aboard the plane." —C. L.

That Gulfpride Oil and Gulf Aviation Gas were used by Benny Howard and Harold Neuman, winners of the two most important events at the 1935 National Air Races—the Bendix and Thompson Trophy races. Another Gulf scoop!

FIRST BALLOON RIDE

"Not man, but a sheep, a rooster and a duck were heroes of the first balloon ride.

"When the hapless beasts were put in the basket and the balloon began to rise, some people swore they would freeze,

others that they would choke in the cold, rare air above.

"But when the balloon came to earth and the basket was opened, one barnyard braggart strutted, the other quacked, and the sheep just chewed its cud as if nothing at all had happened." —W. R.

THIS MONTH'S WHOPPER

"Ted R. was a nut about Gulf Aviation Gas—simply wouldn't use anything else.

"We were ribbing him one day about it, when somebody said, 'If Gulf Aviation Gas is half as good as you say it is, you ought to rub some of it on that old bald head of yours and grow some hair.'

" 'Darned if I won't,' he replied—and started to do it.

"In a few days fresh blades started cropping through that shiny pate of his, and in a month he had a real crop of hair.

"But it was the craziest hair you ever saw. Wouldn't lie still, but kept twisting and whirling—each hair giving a first class imitation of a propeller on a ship.

"Ted went to a barber to have his hair cut real short, but the hair moved so fast the barber couldn't catch it with his scissors.

"So Ted told him to shave the pate off clean. The barber followed orders and Ted felt happy—*for a few days!* Then the hair started coming in again same as before. So he had it shaved again—and again the hair sprouted up.

"It's finally reached the stage where Ted's almost batty and would give his house and lot and maybe his wife and youngster, too, for anybody that could *stop* his hair from growing.

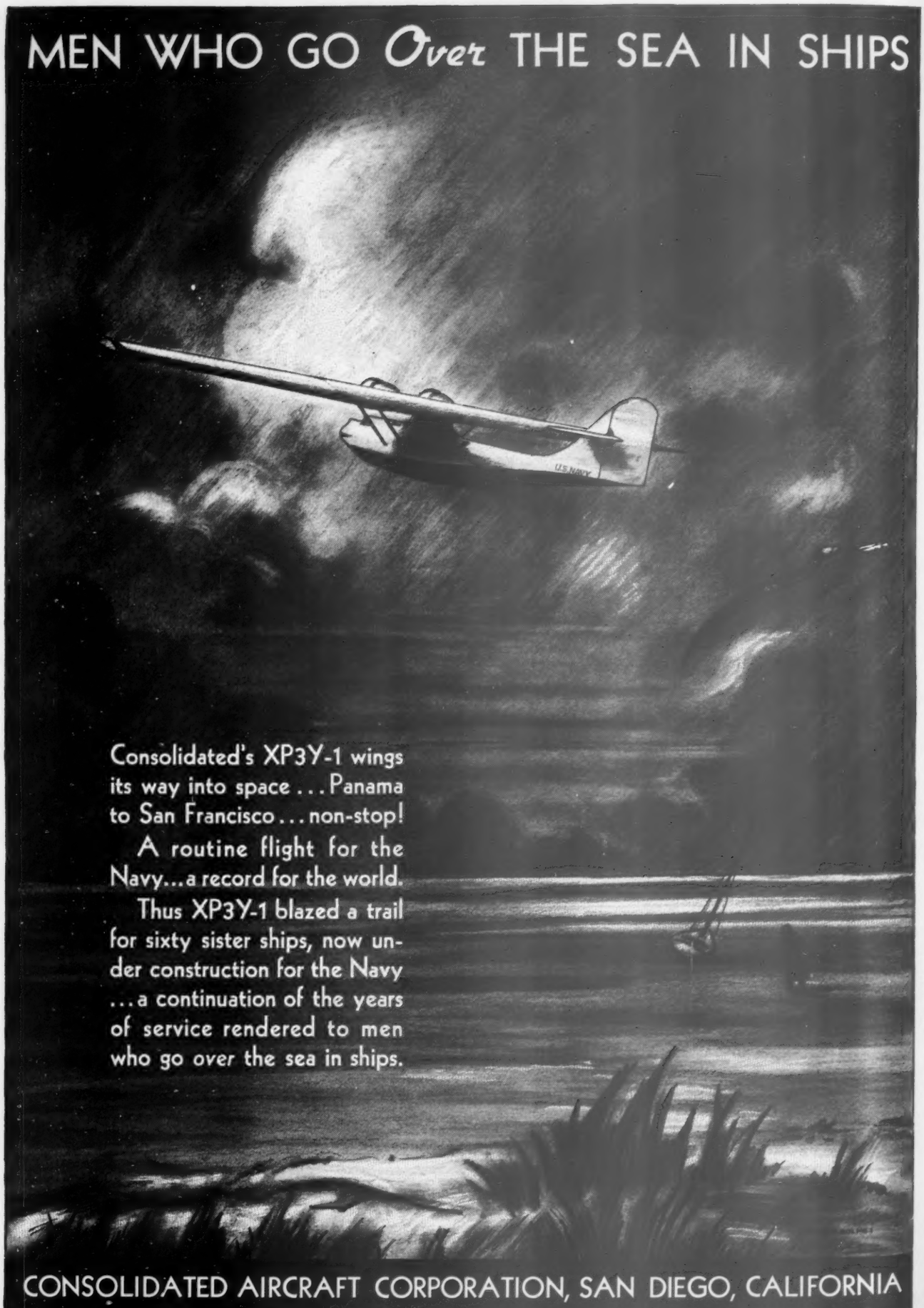
"The boys suggest a concrete night-cap. Have you any ideas?" —H. S. W.

Gulf Oil Corporation of Pennsylvania ...Gulf Refining Company...makers of

GULF AVIATION PRODUCTS

GULF

MEN WHO GO *Over* THE SEA IN SHIPS



Consolidated's XP3Y-1 wings its way into space . . . Panama to San Francisco . . . non-stop!

A routine flight for the Navy . . . a record for the world.

Thus XP3Y-1 blazed a trail for sixty sister ships, now under construction for the Navy . . . a continuation of the years of service rendered to men who go over the sea in ships.

CONSOLIDATED AIRCRAFT CORPORATION, SAN DIEGO, CALIFORNIA

War Department Appropriation Bill the House's 10 per cent profit limitation for plane and ordinance suppliers. The bill has gone to conference for final adjustment.

North Atlantic

Air France enters race, LZ-129 grooming for regular Germany-U. S. service

THIRD European country to discuss airline operation across the North Atlantic was France. Early in March Jean Schneider, secretary general of Air France, Baron Amaury de la Grange, member of the French Senate Committee on Aviation, Morin de Linclays, of the French Line, and Edmond Lanier, secretary of the French Line directorate, appeared in Washington for discussions with the Interdepartmental Committee on Civil International Aviation. Also present were Pan American's Juan Trippe, and Thomas A. Knowles of Goodyear Zeppelin. Reported Chairman R. Walton Moore two days later: The French would be permitted to make trial flights to this country next summer provided the United States was accorded the same privilege by France.

Late in the month lighter-than-air took the lead in the transatlantic picture. Germany's new 813 ft. dirigible, Graf von Hindenburg (LZ-129), flew from Freidrichshafen to Brazil, starting March 31 and arriving at Rio de Janeiro April 4. Early in May she will inaugurate regular seven-day round-trip service between her new base at Frankfort and Lakehurst, N. J. (See also page 15.)

Knickerbocker's Airport Problem

New York receives setback on Floyd Bennett, a boost on Governor's Island

IN A MEMORANDUM dated March 21, PMG Farley settled (once more) the long standing argument between Newark and Floyd Bennett Field as New York's airmail terminus by ruling in favor of the former. Chief reasons for his decision were: (1) no evidence had been offered to show that air mail could be served better from Floyd Bennett field than from Newark Airport and (2) that nothing had been produced in rebuttal of the prior position taken by the Post Office Department that air mail could be handled more cheaply from Newark than from Floyd Bennett.

Although one down on the Newark situation, New York authorities saw a ray of hope in a vote by the House Military Affairs Committee on the Peyser bill which would authorize the use of a part of Governor's Island for the construction of a passenger, mail and express terminal. The project involves enlargement of the northwest corner of the island by some 70 acres to accommodate landing strips. No funds are to be provided by the Federal Government for either the preliminary work or for maintenance. The City of New York has agreed to put up some $3,000,000 for construction and to defray the operating expenses. The field would still be held available for military purposes in emergencies. The intention is not to provide a complete base terminal with hangars and shops, but merely to make available a transfer landing point to facilitate air traffic to and from the City of New York.

Financial

Year-end reports show gains for TWA, Bendix, Consolidated, Curtiss-Wright, Waco, Sperry

TWA reported a net profit for 1935 of $19,404 after providing for $905,899 of depreciation. A total of $829,300 was spent for new equipment.

Passenger and cargo revenue for United Air Lines was up 22 per cent last year over 1934, which cut operating loss to only $1,392, or only 1⅓ mills per share, compared with a $2.19 per share loss in 1934. This in spite of a 12 per cent cut in rate of mail payments.

Western Air Express showed a loss of $8,188 last year. Gross revenues amounted to $586,989, up $207,780 from the previous year.

Bellanca Aircraft Corporation reported a loss of $194,221.

Boeing Airplane Company and subsidiaries (Boeing Aircraft and Stearman Aircraft) showed a net loss of $333,800, with gross sales of $1,236,517.

The picture was brighter for Bendix Aviation Corporation, which earned $3,163,921, or $1.51 a share.

Consolidated Aircraft Corporation reported earnings of $322,731 last year. This amounted to 56 cents a share, as compared with 1 cent a share for 1934.

Earnings last year for the Curtiss-Wright Corporation were $2,886, compared with $359,737 the previous year.

The Glenn L. Martin Company sustained a loss of $318,364 in 1935 as against $59,849 loss in 1934.

United Aircraft Corporation stockholders approved March 3 issuance of 450,000 new shares of stock, at $5 par value. The company expects to raise about $6,500,000, which will be used for expansion of manufacturing facilities.

Waco Aircraft Company reports a net sales increase from $895,421 in 1934 to $1,235,902 last year, yielding a profit of $4,522 instead of 1934's $66,966 loss.

The Sperry Corporation earned $1,651,461 in 1935, which included a profit of $367,875 from security sales.

One for All

Five airlines join in development of 40-passenger airliner

AFTER many months of executive conference and engineering discussion, five of the major airlines have issued an announcement that they have joined forces in drawing up specifications and placing an order for a four-engined 40-passenger airplane, a design which, when completed, may be adopted as standard by the five companies involved.

It has been no secret around the aviation industry during the past six months that active engineering work has been on foot at the Douglas plant on such a machine. Engineers, pilots, company executives have spent a great deal of time in Santa Monica making and remaking a huge mock-up and conferring on engineering changes. Of interest to readers of AVIATION is the fact that Edward P. Warner, former editor of this magazine, has been representing United Air Lines on the project, and has been responsible in large measure for writing the specifications.

Douglas gets the first order, a $500,000 contract for one machine, the cost to be shared jointly by Transcontinental and Western Air, American Airlines, Eastern Air Lines, United Air Lines and Pan American Airways. Subsequent units are expected to cost in the neighborhood of $200,000 to $250,000 each. Delivery of the experimental unit is expected by the spring of 1937.

Preliminary specifications released indicate that the machine will be designed to carry 40 passengers for 900 mile non-stop runs, or 20 passengers in sleeping compartments 2,000 miles non-stop. A top speed of 230 m.p.h., and cruising at 193 m.p.h. at 60 per cent power is anticipated. Four engines, each furnishing 1,000 hp. for take-off and a maximum of 900 hp. at 9,000 ft. (manufacturer as yet unannounced) will be carried in leading-edge nacelles. The ship will be all-metal, resembling the DC-2s and the DSTs. Wing span is to be 140 ft., fuselage 95 ft. long. Passenger cabin is 10 ft. wide, 40 ft. long. A variety of interior accommodations are possible. Separate dressing rooms and lavatories will be available for men and women. A galley with a capacity of meals for 40 people will be installed. The ship will be completely soundproofed and will be designed for automatic heating and ventilation.

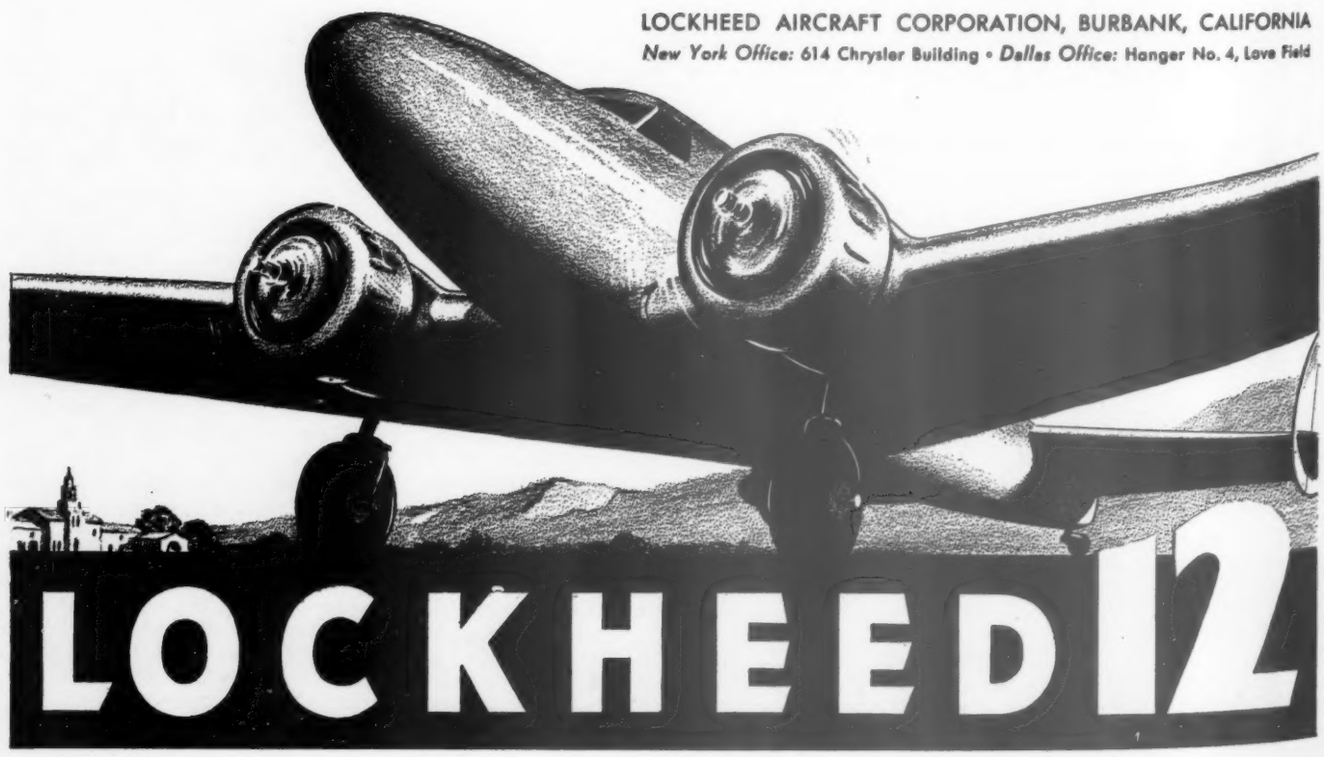
Contrary to some earlier opinion, the cabin is not to be supercharged for substratosphere flying. Arrangements will be made to bleed oxygen into the ventilating system, however, so that the ship may be operated for short periods at altitudes up to about 25,000 ft.

IF THE AUTOMOBILE MADE THE NATION A NEIGHBORHOOD...

The Lockheed 12 Will Make Your National Organization A Family

Here is a *new* airplane that offers you a *new* economical method of unifying your company's scattered interests and personnel. It will give your company swift transportation with airline dependability — but suited to *your own* time and destination. ● Designed after six million miles of operating experience with the famous Lockheed Electra, the new 12 carries eight in its sound-proofed fully-equipped cabin. It has a top speed of 231 m.p.h. and a non-stop range of 650 miles. It has two engines, retractable landing gear, flaps, double rudder, ample baggage accommodations, and all-metal construction. ● The new Lockheed is available for spring delivery, and may be financed over a two-year period if desired. May we send you complete data?

LOCKHEED AIRCRAFT CORPORATION, BURBANK, CALIFORNIA
New York Office: 614 Chrysler Building • *Dallas Office:* Hanger No. 4, Love Field



LOCKHEED 12

Schools, Services, and Airports

● ALABAMA—The airport at ALEXANDER CITY was scheduled to be opened early in March with army planes from Maxwell Field participating in the ceremony. . . . A number of new students are keeping Glenn Messer's Travelair busy at the BIRMINGHAM Municipal Airport.

● ARKANSAS—The Bureau of Air Commerce has approved expenditure of $160,000 for reconstruction of runways at LITTLE ROCK Municipal Airport. The work will be done by the WPA and will include a north and south runway 3,500 ft. long and a 100 ft. wide taxi strip. A $58,000 administration building and hangar is also being considered.

● CALIFORNIA—The Curtiss-Wright Technical Institute of Aeronautics, at Grand Central Air Terminal, GLENDALE, has started a night course in aircraft metal fabrication. The school reports substantially increased enrollment in January. . . . Pierce Brothers Flying Service, EUREKA, has bought a new 170 hp. Waco three-place biplane, which will be used for charter work. . . . A new voice transmitter is being installed by the Bureau of Air Commerce at Lindbergh Field, SAN DIEGO. . . . Kenneth R. Brooks is bringing two new planes to RIVERSIDE Airport, where he will assist Roman Warren in the management of the field. The management expects to provide additional hangar space and is prepared to expand instruction activities. . . . The 65 ft. poles carrying high tension wires along the east boundary of Los ANGELES Municipal Airport have been removed, along with a number of trees, providing a clear approach to the main runway 2,000 ft. wide. The next obstruction to be removed will be the telegraph lines of the Santa Fe Railroad. . . . The WPA will spend $444,705, which will be supplemented by $93,375 supplied by the city of Los ANGELES, in the development of Los Angeles Harbor Airport as a naval air field. Plans call for construction of a concrete seaplane ramp 175 ft. long and 35 ft. wide, dredging of a mooring base for seaplanes, and construction of asphalt and concrete runways on Terminal Island for use of land planes. . . . The WPA has provided $33,000 for construction of an administration building and hangar and installation of a drainage system at MERCED Municipal Airport. . . . Major C. C. Moseley, president of Aircraft Industries, Inc., Grand Central Air Terminal, GLENDALE, has taken delivery of a new Stinson Reliant.

● COLORADO—A $15,000 WPA project providing paved runways and a new drainage system was scheduled to get under way at the municipal airport in DENVER late in February. The WPA is considering an application for an additional allotment of $120,000 for construction of a combined National Guard hangar and administration building.

● CONNECTICUT—A club to encourage flying has been formed at WATERBURY, under the presidency of Lincoln Whittaker. Horace B. Wetherell, of HARTFORD, will be flying instructor. . . . The Reliable Flying Service, Inc., Stephenson Field, BRISTOL, is conducting a night ground school. The company also plans the purchase of a new light plane for student instruction.

● DELAWARE—Although the DOVER Airport Corporation has been dissolved, D. M. Wilson, who owns the land, will keep it open as a landing field.

● DISTRICT OF COLUMBIA—Congress has finally passed a bill authorizing a guard to patrol the section of Military Road that passes through Washington-Hoover airport. Heretofore the guards have been employed by the airport and had no authority to enforce their commands. The guard will continue until Congress provides a permanent airport for the city. Although by terms of the bill the road must be kept open to traffic, the airport is authorized to level a section of it for use as a runway.

● FLORIDA—A $45,000 hangar is being erected at Peter O. Knight Airport, TAMPA, and materials for a $23,000 seaplane ramp have been ordered. The WPA is also planning hangars at PUNTA GORDA, WINTERHAVEN, MELBOURNE, PALM BEACH and ORLANDO.

● GEORGIA—Representatives from MACON, SAVANNAH, MONTGOMERY (Ala.), MERIDIAN and JACKSON (Miss.), were scheduled to meet in Columbus late in March to consider establishment of an air line from SAVANNAH to JACKSON. . . . The city of THOMSON and McDUFFY COUNTY have purchased 60 acres of land between THOMSON and WARREN which is being made into an airport as a $2,800 WPA project.

● IDAHO—The Bureau of Air Commerce has approved a WPA expenditure of $61,756 at POCATELLO, which will provide for two 4,300 ft. runways, graveling of taxi strips and installation of additional obstruction lights. From a $43,000 fund previously approved, the field will have two new hangars and a radio and weather office. . . . Representatives of BOISE, TWIN FALLS, BURLEIGH and POCATELLO are considering establishment of an airline across the State. . . . TWIN FALLS Chamber of Commerce will try to raise $4,800 for purchase of a 480-acre airport site, which is now leased from the state. If the drive is successful, $68,000 of WPA funds will be available for its improvement.

● ILLINOIS—A new hangar will be erected at the DEKALB County Airport to replace the building recently destroyed by fire. . . . A teletype machine for reporting weather conditions has been installed at PEORIA Airport. It will operate 24 hours a day. . . . Miss Jane Ray, CHICAGO, has been appointed an inspector for the Illinois Aeronautics Commission.

● INDIANA—The Bureau of Air Commerce has approved a WPA expenditure of $49,536 for improvements at CULVER Municipal Airport. . . . A WPA expenditure of $160,000 for construction of new runways at Paul Baer Municipal Airport, FORT WAYNE, has been approved by the Bureau of Air Commerce. Funds for the installation of a radio range beacon and boundary lights have already been made available.

● KANSAS—George Harte, who operates the Harte Flying Service, Kellogg Airport, WICHITA, has been appointed distributor for Porterfield planes. . . . The Bureau of Air Commerce has approved plans for the improvement of Atkinson Municipal Airport, PITTSBURG. The project will cost $3,698, and will be financed by the WPA. . . . CHANUTE city officials are planning expenditure of $28,000 for surfacing of runways at CHANUTE Municipal Airport. . . . WPA will spend $120,000 at Kellogg Municipal Airport, WICHITA, for landscaping and construction of highways leading to

the field. The United States Weather Bureau recently agreed to install full 24-hour service at the field. Service was curtailed last spring as an economy move.

● LOUISIANA—Claude Gardner and Bruce Byrd, operator and assistant operator of the radio station at SHREVEPORT Municipal Airport, are conducting a radio school at the field, specializing in code and radio theory as it applies to aviation. Thirty men have enrolled.

● MAINE—The WPA is constructing a new north-south runway at CARIBOU. 55,000 cu.yd. of fill will be needed and it is going in at about 300 yd. a day. . . . BANGOR is considering supplying $17,000 to secure a $97,000 WPA fund for improvements at Bangor airport.

● MARYLAND—BALTIMORE is seeking $2,000,000 from the PWA for improvement work at Baltimore Airport. The state PWA has already approved the outlay. If it is approved in Washington, the city will contribute 55 per cent and the PWA the other 45 per cent.

● MASSACHUSETTS — John H. Shobe reports a total of 147 hours fifteen minutes of charter flying from BOSTON Municipal Airport in February. He has taken delivery on a new plane for student instruction. . . . The HOLYOKE Board of Aldermen has voted in favor of taking over Barnes Airport in cooperation with the city of WESTFIELD. Under the proposed plan each city would contribute $14,000 for improvement work, which would make the field eligible for $80,000 from the WPA. The Westfield City Council has already voted approval of the plan. . . . The WPA is conducting a weekly class in aeronautical engineering at BROCKTON under the direction of Ralph Alex.

● MICHIGAN—Final payment on the public address system installed last summer at Bishop Airport, FLINT, was made late in March. Airport officials are now considering installation of an electrical transcription unit. . . . GRAND RAPIDS Airport is having its administration building remodeled, and recreation fields installed along its northern border. It is planned to install a radio station in the administration building. . . . Bishop Airport, FLINT, has received 17,000 ft. of cable for installation of an airport lighting system, which will include eighteen runway approach lights. Paving of 500 ft. at the end of each runway will start in May. . . . WPA has approved expenditure of $33,050 for improvement work at SAGINAW Municipal Airport. The city will contribute another $1,846. Still to be obtained is approval by the state WPA administration.

● MINNESOTA—The MINNEAPOLIS chapter of the National Aeronautic Association will sponsor an air pageant at Wold-Chamberlain Field in June. The pageant will be preceded by an air tour of Minnesota and adjoining states. Arrangements for the pageant are under the direction of Paul Burwell. . . . The MINNEAPOLIS Board of Estimate and Taxation has voted to sell $50,000 in bonds to finance the city's share in a federal aid project for construction of hard surfaced runways at Wold-Chamberlain Field. The total cost of the project is estimated at $250,000. . . . The new United States Weather Bureau Observation Station at ST. CLOUD Airport has been completed. It is operating on a 24-hour-a-day schedule. . . . 750 towns in MINNESOTA will benefit from a WPA air marking project to cost $51,646. Work, under the direction of the Minnesota Aeronautics Commission, will start in the spring. . . . The WORTHINGTON City Council has authorized application for a license for Worthington Airport.

● MISSISSIPPI—City engineers of JACKSON are planning construction through the WPA of a new administration building at the municipal airport. Grading work on the field is nearly completed, and a concrete floor has been installed in the hangar.

● MISSOURI—R. C. Clayton, R. C. Downing, Leonard Trowbridge and Arch McElwen have formed the Missouri Aviation Company at SPRINGFIELD Municipal Airport. The company has bought two planes to be used for instruction and plans to buy two more.

● NEBRASKA — The BLOOMFIELD Lions Club has appointed a committee to study acquisition of a site for an airport. . . . The OMAHA City Council has approved appointment of Rudy C. Mueller as manager of the municipal airport. . . . The State Aeronautics Commission has asked for bids on a four-place cabin plane for the use of the commission. The plane will be paid for out of proceeds from a state tax on aviation gasoline. . . . WPA is planning extensive improvements at NORTH PLATTE Municipal Airport. Plans calls for three concrete runways from 3,250 ft. to 4,200 ft. long and 100 ft. wide, and construction of a hangar, passenger station and two-story administration building.

● NEVADA—The Airplane Pilots and Operators Association has been organized at RENO. Officers: Harry Frost, president; Dr. Dwight L. Hood, vice-president; and Mark Peters, secretary-treasurer.

● NEW JERSEY—The Casey Jones School of Aeronautics, NEWARK, has placed 30 graduates in jobs since the first of the year. Spring classes, which started on March 9, total 40 new aeronautical engineering and master mechanic students, which brings the school up to its capacity. . . . NEWARK Airport reports that more than 200,000 airline passengers used the field during 1935, with air express at 1,151,000 lb. and air mail at 2,744,000 lb.

● NEW YORK—The SYRACUSE Common Council has voted to buy 63 acres of land adjoining the Municipal Airport at AMBOY. The land will cost $10,000 plus back taxes and will make the field

ROUND TABLE
meeting of the Association of New England College Flying Clubs. The parent organization, the National Intercollegiate Flying Club, met in Washington March 31 and April 1.

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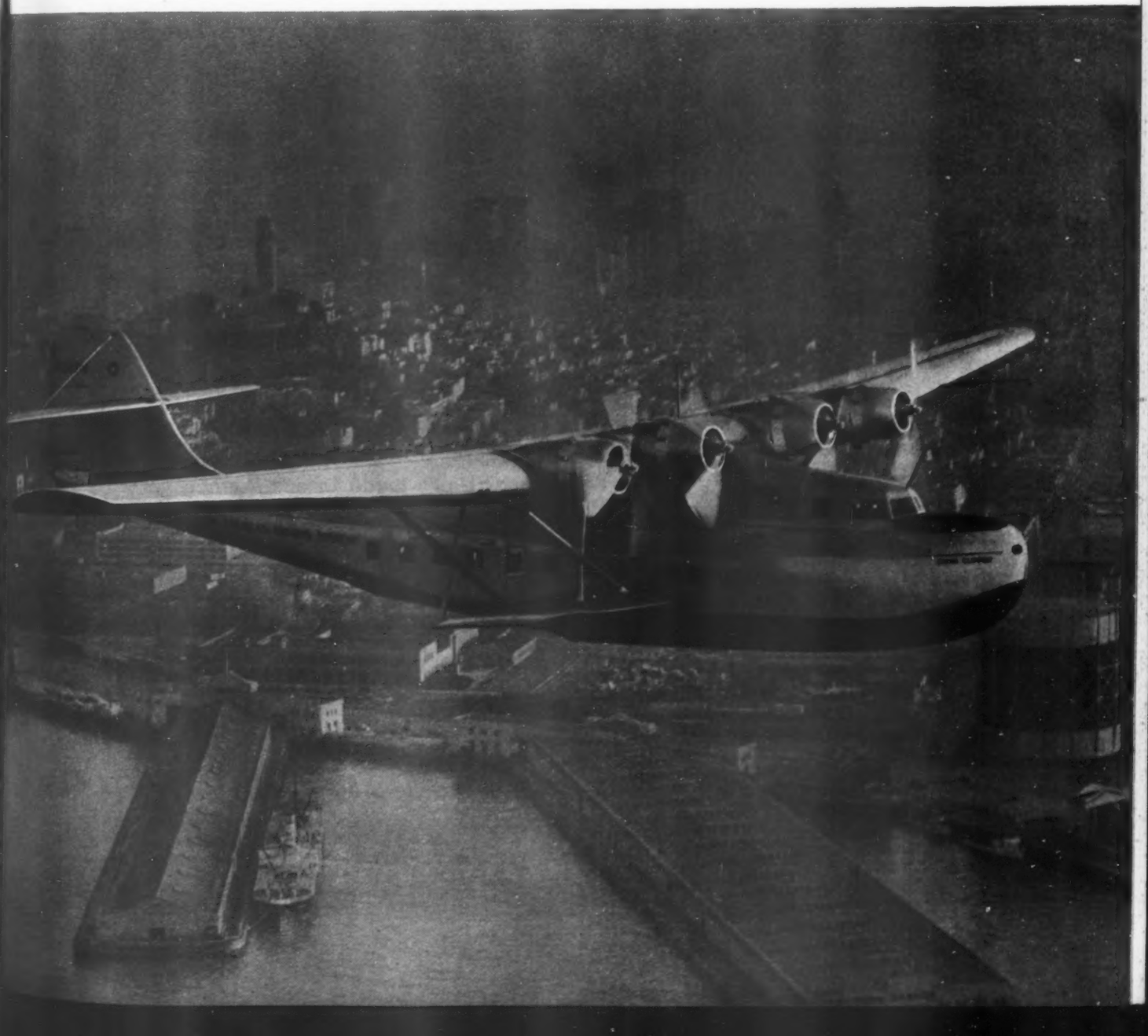

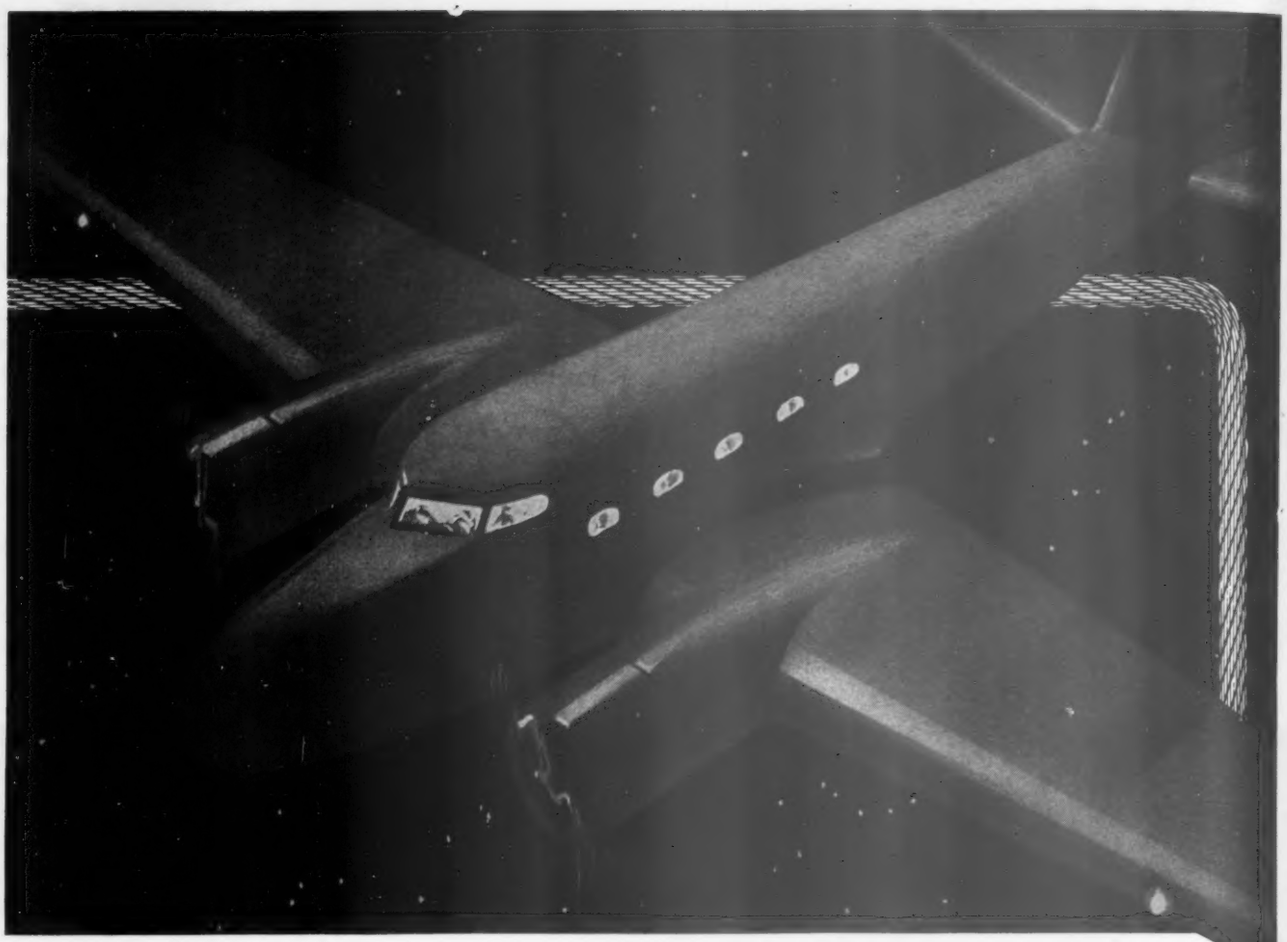

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eligible for a $200,000 WPA improvement fund for construction of a new north-south runway. . . . POUGHKEEPSIE Airport will be taken over by Roger Gardner. John Ray, present operator, was Gardner's instructor. . . . George W. Orr has been re-elected president of Roosevelt Field, Inc., MINEOLA. Other officers: W. D. Guthrie, treasurer and vice-president; A. C. Kennedy, secretary; John W. Hanes, chairman of the board. Roosevelt Aviation School, which has been headquartered at Field One, will move to Field Two early in the spring. A race course is to be constructed on Field One.

● NORTH CAROLINA—The Carolina Aero Club was host to seventeen planes in an exhibition of stunt flying at MORGANTON in March. More than 5,000 spectators turned out for the event. Officers of the club: Dr. F. M. Boldridge, president; Miss Mary Nicholson, secretary. . . . The WPA has granted $53,140 for extension of runways and installation of lights at WILMINGTON Airport. . . . John Harmon, student instructor for the Camel City Flying Service, Miller Municipal Airport, WINSTON-SALEM, brought two new ships to the field in March—a Taylor Cub and a Stinson Reliant. The Reliant will be used for cross-country charter flights, and the Cub will be used for student instruction. . . . Robert L. McKee has taken a three year lease on SALISBURY Municipal Airport. He will bring two planes to the field. . . . The Nelson-Cannon Aircraft Sales & Service Company has been organized at CHARLOTTE Airport. The company will have the agency for Waco planes and will be sub-distributors of Taylor Cubs. A flying school and airplane repair shop is also planned.

● OHIO—The General Airmotive Corporation has taken a long term lease on the former Thompson hangar at CLEVELAND Airport. The company, headed by James W. Borton, specializes in engine service and is also the airport distributor for the Gulf Refining Company. . . . DAYTON citizens have subscribed $42,600 toward the $65,000 purchase price of the airport at VANDALIA. Purchase of the field would make it eligible for from $400,000 to $700,000 from the WPA for improvements. . . . Ray Vaughn and Willis Sperry, who operate Mid-City Airport, HUDSON, report 35 active students in their club plan for flying instruction, which permits solo time in Taylor Cubs at $4 an hour.

● OKLAHOMA — OKLAHOMA CITY municipal airport has received $75,711 from the WPA for construction of an Army Air Corps Reserve hangar. . . . MUSKOGEE is planning construction of a 100x2,500 ft. concrete runway at the municipal airport if the WPA approves a $95,000 project.

● OREGON—The Bureau of Air Commerce has approved the expenditure of $14,175 for improvement work at SALEM Airport. Most of the money will be spent graveling the runway. . . . The Sohler Flying Service has been incorporated in SALEM to provide passenger service between BEND and PORTLAND. Incorporators are: Myrle P. Hoover, L. J. Sohler and William Niskanen. The company will use a Travelair.

● PENNSYLVANIA—City officials of OIL CITY are seeking WPA approval of a $113,000 improvement project at Splane Memorial Airport. . . . WPA is constructing a new north-south runway at LANCASTER Municipal Airport. Work already done includes grading and removing outcroppings of rock . . . . HANOVER is considering establishment of an airport with a $175,000 WPA fund originally allotted to YORK. . . . Work has been started on a municipal airport at MONTOURSVILLE. Plans call for a 125x82 ft. hangar, removing of trees and grading. The airport contains 164 acres of ground. . . . $50,000 of a proposed $173,000 project has been released by the WPA for construction of an airport at MEADVILLE. . . . Piper Training School, Bettis Airport, PITTSBURGH, is considering moving to Pittsburgh-Allegheny County Airport. . . . The State Aeronautical Department will conduct a ground school at WILLIAMSPORT to include lectures on air commerce regulations, airplane engines and airplane design. Instructor: L. F. Probst.

● RHODE ISLAND—The WESTERLY Town Council has applied to the WPA for more than $150,000 for construction of an airport there. The State is planning construction of an airport in WESTERLY, but the town is taking action of its own to insure establishment of the field.

● SOUTH CAROLINA—Beverley E. Howard, manager of the Hawthorne Flying Service at CHARLESTON Municipal Airport, has bought his second Taylor Cub, which will be used for student instruction. He now has five ships at the field. . . . Robert F. Turner of the Turner Flying Service, SPARTANBURG, reports enrollment of seven new students.

● SOUTH DAKOTA—SIOUX FALLS has applied for $208,000 from the WPA for modernizing Sioux Skyways Airport. The plan would include construction of four 3,000 ft. runways, a field lighting system and a new 90x100 ft. hangar, to cost $19,000.

● TENNESSEE—The WPA is constructing two new concrete runways at Lovell Field, CHATTANOOGA. One will be 3,600 ft. long and the other 3,400 ft. long. A hill on the north end of the airport is being leveled off, and the administration building and hangar are being remodeled.

● TEXAS—Work started in February on a new $145,000 passenger terminal at FORT WORTH Municipal Airport. The city has applied to the WPA for $200,000 for further improvements. It is planned to add a new lighting system.

● UTAH—The Bureau of Air Commerce has approved expenditure of $30,194 for construction of an airport at BRYCE CANYON National Park. The project still awaits approval by the State WPA. . . . Completion of the runway and hangar and piping in of city water comprise a $10,311 WPA project at PRESTON Airport. The hangar will be 60x75 ft., with a 60x60 ft. concrete apron adjoining it.

● VIRGINIA—66,000 cu.yd. of dirt will be removed from the runway and approach at Preston Glenn Airport, LYNCHBURG, and the two runways will be paved. . . . The main runway will be extended to 2,500 ft. . . . Southern Airways, Inc., operators of DANVILLE Airport, exhibited a Taylor Cub at the American Legion show in Danville early in March.

● WASHINGTON—The CLE ELUM City Council has approved a WPA expenditure of $16,231 for improvements at Lanigan Field. The city will add $1,014. Work to be done includes lengthening and paving the runway, clearing stumps and erecting field markers. . . . PORT ANGELES Airport will be enlarged by the WPA at a cost of $80,779. When the work is through, the field will be 1,250 ft. wide and 3,750 ft. long with two lighted runways each 300 ft. wide. Runways will be graveled and a 60x60 ft. hangar erected.

● WEST VIRGINIA—Wayde Stewart and Jay Sodowsky, joint managers of PARKERSBURG Municipal Airport, plan to buy a new cabin plane for charter flights this summer. They recently bought a Taylor Cub for student instruction. . . . The HUNTINGTON Chamber of Commerce has successfully completed its campaign to raise $7,500 toward the purchase price of the HUNTINGTON-CHESAPEAKE Airport. An application for WPA assistance in development has been sent to the Ohio State WPA. . . . Thomas H. Smith of the Smith Flying Service, CLARKSBURG, has two new Taylor Cubs and a new five passenger Stinson.

● WISCONSIN—Filling and grading work at Royal Municipal Airport, MADISON, was begun in March. 100,000 cu.yd. of dirt fill will be used. . . . The WPA has granted $8,857 for the air marking program at MILWAUKEE County Airport.

Aviation People

• United Aircraft Corporation, East Hartford, Conn., elected three new directors last month: RAYCROFT WALSH, general manager of Hamilton Standard Propeller Division; BERNARD L. WHELAN, general manager of United Airports Division, and RENSSLAER W. CLARK, assistant general manager of Sikorsky Aircraft Division, who was also elected to the vice-presidency. Mr. Walsh and Mr. Whelan were re-elected vice-presidents. The following officers of the corporation were re-elected: President, DONALD L. BROWN; senior vice-president, E. E. WILSON; vice-presidents, G. J. MEAD, C. W. DEEDS, G. S. WHEAT, and T. F. HAMILTON.

• EARL F. WARD, who has been directing traffic in and out of Newark (N. J.) Airport for the lines using that terminal, has been appointed supervisor for airway traffic control for the Bureau of Air Commerce. His new job will give him responsibility for the establishment and revision of rules and regulations governing airway traffic. The appointment came as a result of increasing intentional instrument flying along congested airways. The new supervisor has been flying since the War—as test pilot for Curtiss Aeroplane & Motor Corporation, as a pilot for the Post Office Department's Air Mail Service, and with National Air Transport. From 1927 until he was recently drafted into service at Newark, he was with American Airlines. The present appointment is one result of a comprehensive study of airport and airway traffic control by the Bureau.

• MAJ. LAWRENCE G. BROWER, general manager of General Air Express before its lines were merged in the Air Express Division of Railway Express Agency last February, has been appointed eastern sales representative of the division.

• Death came to CAPT. KARL G. E. GIMMLER, attached to the First Pursuit Group, Selfridge Field, while engaged in gunnery practice at Shreveport, La. Flying with the Army since his graduation from West Point in 1924, Captain Gimmler last October won the eleventh annual Mitchell Trophy Race at Selfridge Field.

• After seven years with Boeing at Seattle (Wash.) JOHN HARDING, JR., has moved down the Coast to Los Angeles and the Menasco Manufacturing Company. He served Boeing as liaison engineer between the company and users of Boeing planes. At Menasco he will work with both sales and promotion of the company's inverted in-line air-cooled engines.

He started his aviation career in 1917, with the Army Air Corps, and served at Wright and McCook Fields. In 1924 he was assigned to the Army's globe-girdling flight, as assistant engineering officer, and was co-pilot and mechanic of the New Orleans, one of the two planes to complete the flight.

Donald Brown

Lawrence Brower

John Harding, Jr.

Thomas Wolfe

• STEPHEN J. ZAND, aeronautical research engineer of the Sperry Gyroscope Company, has returned from a six-months' tour of duty in Europe. Most of his time was spent in France, soundproofing the flying equipment of Air France for the French Government. April 3 he spoke at a special meeting of the Institute of the Aeronautical Sciences on "Aviation in Europe as I saw it."

• ALVIN P. ADAMS, president of Western Air Express, has announced the appointment of THOMAS WOLFE as general traffic manager for the line. He assumed his new post Feb. 20. He has been secretary for the Chicago Aero Commission, and district traffic manager in Chicago for United Air Lines. For six years he has been instructor on air transportation at Northwestern University. He succeeds GEORGE CUSSEN, who recently resigned to became traffic manager, Western Region, TWA.

• For "extraordinary achievement" with the second Byrd antarctic expedition WILLIAM MILTON BOWLIN, of Indianapolis (Ind.) has been awarded the Distinguished Flying Cross. His citation said that "he showed great skill in climbing through clouds in order to be able to use the sun compass for accurate navigation and he used rare judgment in the maneuvering of the plane so as to prevent ice formation from causing a forced landing."

• With the retirement of Col. Charles H. Danforth, LIEUT. COL. WALTER R. WEAVER has been named executive officer of Langley Field, Va. Colonel Weaver entered West Point in 1903, graduated from the aero service pilots' school in 1921, the aero service bombardment school the same year, and the advanced flying school special observation course in 1927. He has been in the Air Service since 1920, and won his present commission in 1932.

• For sticking to his radio operator's post in last May's influenza epidemic in Alaska, although ill himself at the time, SERGEANT STANLEY A. MORGAN has received the Soldier's Medal, the highest peacetime award attainable by an enlisted man.

• JEROME FOX LEDERER will give a series of lectures on air transportation at the Daniel Guggenheim School of Aeronautics, New York University. He will be on familiar ground, as he graduated from the University's Aeronautics School in 1924. After a trip to Europe to investigate technical applications of aluminum silicon alloys, in 1926 he was put in charge of the engineering department for the Post Office's Air

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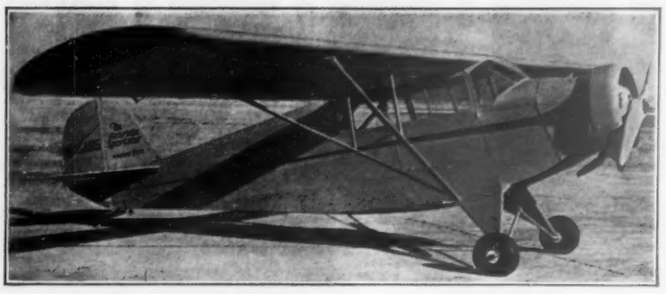

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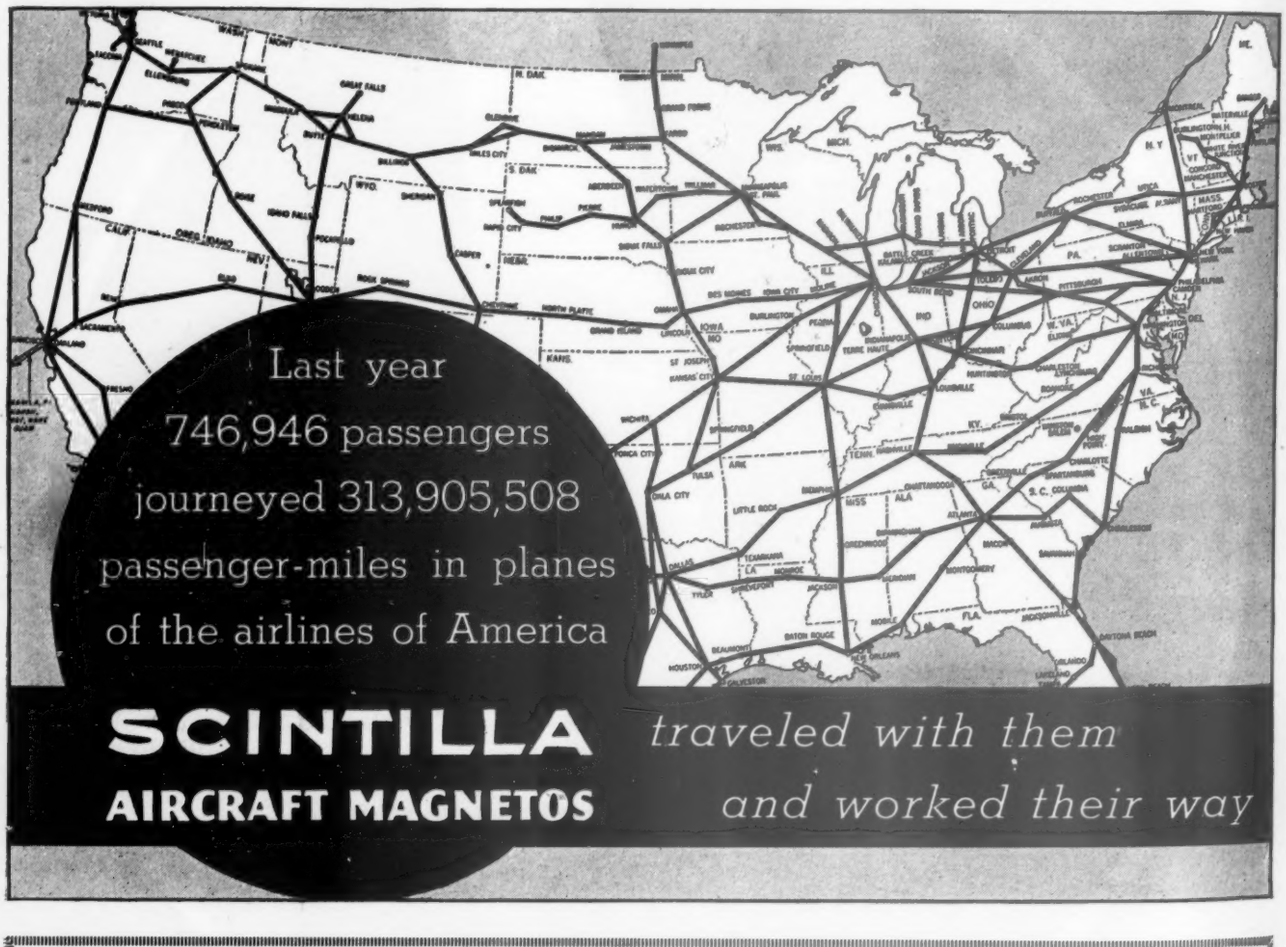

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Mail Service. He then went into business for himself, organizing Aerotech, Inc., aeronautical engineers, in 1927. He has been with Aero Insurance Underwriters (formerly Barber & Baldwin, Inc.) since 1929, studying methods for improving safety in aviation.

• The Air Transport Association of America has elected PAUL H. BRATTAIN chairman of its traffic and sales committee. Mr. Brattain is general traffic manager of Eastern Air Lines.

• After seventeen years as general superintendent of the Glenn L. Martin Company, LESTER BENSON has resigned to become Factory Manager for the Bell Aircraft Corporation, Buffalo, N. Y. He takes with him experience gained in supervising construction of flying boats for the Navy, bombers for the Army, and Pan American's huge trans-Pacific Clippers. His first job with Bell will be fulfillment of an $800,000 contract from the Consolidated Aircraft Corporation for construction of outboard wing panels for the Navy's new fleet of 60 twin-engined P3Y-1 patrol boats.

• Vincent Bendix has announced the appointment of HARRY L. BILL to the executive staff of The Bendix Aviation Corporation. Mr. Bill has had 30 years' experience in the automotive field, starting in 1906 with the Corbin Motor Vehicle Company of New Britain, Conn. In 1909 he became chief of engineering research for the Chalmers organization in Detroit, and soon became factory manager. During the War he was in charge of civilian and factory employees at McCook Field, Dayton. He has spent the past thirteen years as vice-president and general manager of the Owen Dyneto Company, Syracuse, N. Y.

• The War Department announced in February the temporary promotion of LIEUT. COL. FRANK M. ANDREWS to the rank of brigadier general in command of the GHQ Air Force.

LIEUT. COL. HENRY H. ARNOLD, commander of the Pacific wing, and LIEUT. COL. HENRY C. PRATT, commander of the Atlantic wing, are promoted to the rank of brigadier general. LIEUT. COL. GERALD C. BRANT, commander of the central wing, LIEUT. COL. DELOS C. EMMONS, Hawaiian wing, and LIEUT. COL. WILLIAM C. MCCHORD, Panama wing, are promoted to the rank of colonel.

• Northwest Airlines, has established a special women's traffic department with MRS. CHARLES HOLMAN, widow of the famous "Speed" Holman, as director. With headquarters in Minneapolis, Mrs. Holman was scheduled to leave shortly after her appointment on a lecture tour, visiting northwestern women's clubs and organizations.

Side Slips

By Robert R. Osborn

WE SEE by the papers that Mr. Ford has made an adaptation of his V-8 automobile engine for use in a small sport airplane, both engine and airplane now reported to be undergoing flight testing. Being familiar with some of the remarkable uses for Ford Model "T" engines in the past, we can forsee in the near future a scene like the following on the average American farm:

Farmer's Daughter: Dad, may I use the engine for the airplane this afternoon? I want to go over to town for the rehearsals for the Little Theatre Group. It's only about two hundred miles each way.

Farmer's Son: Nothing doing! You know perfectly well that this is the afternoon for the speed boat races on the river, and I've just finished tuning up the engine for the first race of the year. Now if I can't have the engine on Wednesdays this summer there's no use my starting in this year's regattas at all.

Farmer's Wife: Oh, dear—And I was hoping to have the car this afternoon so that I could attend the weekly Bridge Club Meeting.

Farmer: Well, I'll settle the argument—none of you can have that engine today. I'm going to use it on the pump at the irrigation ditch—we're getting too low on water.

Hired Man: Hope you get through with it in time for me to use it for the milking machine!

IT WAS very disappointing that the Queen of the Nudists of the San Diego Exposition was not allowed to alight at Newark airport in the nude, after flying

all of the way across the continent for just that purpose. And as both the airline and Newark airport officials announced ahead of time that the "Queen" would not be permitted to appear in the nude on their property, we think Mayor LaGuardia lost a golden opportunity to make his official New York airport more popular than Newark airport.

THE United Press reports a new type of parachute which will be used in forest fire fighting, dropping the fire fighters right at the scene of the fire—"Preliminary tests here indicate that the 'chutes will enable fighters to attack fires at their source. The biggest advantage is the fact that as soon as a forest fire is spotted, no matter how inaccessible the region, an airplane may take off and drop men at the fire within a few minutes, 'spot-

ting' it from a height of about 150 ft. . . . It differs from an ordinary parachute and is larger—thirty feet across. A small rubber tube is sewed around its perimeter and inflated with air, which causes it to open instantaneously. The parachute is packed in a circular canvas pack fastened on the floor of the plane. The jumper descends a metal ladder until suspended by the parachute lines. The pilot merely locates the fire, circles low over a good landing spot, and releases the jumper."

No thanks—this reminds us not to join up with the United States Forest Service either. We'll stick to our South Sea island.

THE United Press carries an item which brings to mind Heywood Broun's statement of many years ago, that "Fame is as fleeting as a ferry-boat shoe shine."

"Melbourne, March 11 (UP).—The 'Square of Fame' a wall in the Brickmakers' Hotel, near Melbourne's chief airport, on which were written many famous names in aviation, has been destroyed. The wall crumbled during renovations. About 1,000 pilots had written their names on the wall and drawn a line near their signatures to indicate their heights. Names which figure largely in the history of aviation in Australia included those of Sir Charles Kingsford Smith and Flight Lieutenant C. T. R. Ulm.

AND NOW that we are discussing the brilliant past of aviation for the moment, the present state of military and political affairs in Europe and in the Orient makes us wonder what ever became of the effect of all those long distance airplane flights which were made for the purpose of "promoting amity between nations"?

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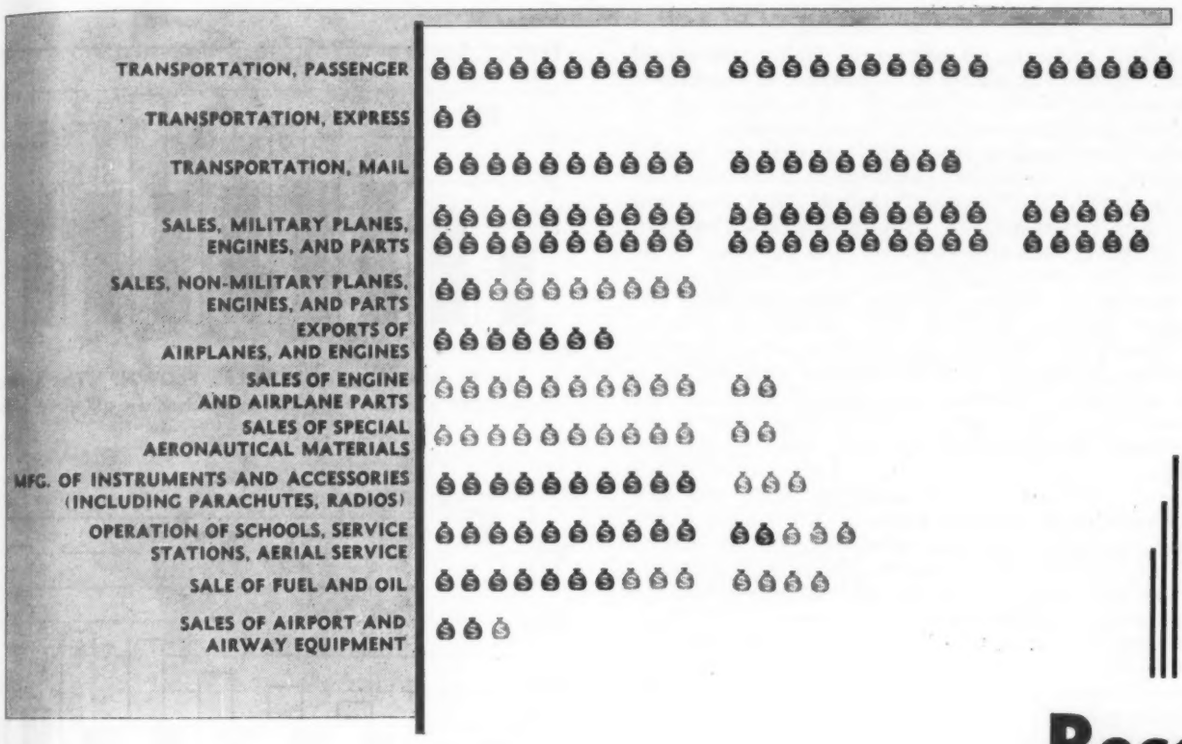
Supplement to AVIATION *for April, 1936*


TRANSPORTATION, PASSENGER
TRANSPORTATION, EXPRESS
TRANSPORTATION, MAIL
SALES, MILITARY PLANES, ENGINES, AND PARTS
SALES, NON-MILITARY PLANES, ENGINES, AND PARTS
EXPORTS OF AIRPLANES, AND ENGINES
SALES OF ENGINE AND AIRPLANE PARTS
SALES OF SPECIAL AERONAUTICAL MATERIALS
MFG. OF INSTRUMENTS AND ACCESSORIES (INCLUDING PARACHUTES, RADIOS)
OPERATION OF SCHOOLS, SERVICE STATIONS, AERIAL SERVICE
SALE OF FUEL AND OIL
SALES OF AIRPORT AND AIRWAY EQUIPMENT

Record of Progress

LAST YEAR when we made our evaluation of the aircraft industry in terms of purchasing power, we pointed with justifiable pride to the fact that within the two years between 1933 and 1935 the total had swelled from $110,000,000 to $167,000,000. Once again we are able to forecast substantial growth, to justify again the titling of our annual survey a record of progress. The money-bags stacked on the several shelves of the industry shown above (each bag representing a potential expenditure of $1,000,000) total 183 for the calendar year 1936. The solid black symbols represent money that comes into the industry from outside its own boundaries. The grey symbols represent our estimate of money that will be spent within the industry in the form of purchases of parts, materials, and supplies by one division from another.

A few comparisons, shelf by shelf, with last year: passenger transportation should be up 20 to 25 per cent; mail revenues will be-main substantially the same; military purchases should up 15 to 20 per cent; instrument and accessory sales about 30 per cent; fuel and oil sales about 30 per cent; and the schools and flying services should advance close to 40 per cent in volume. With WPA money available, it should be possible for suppliers of airport and airway equipment to increase their sales about one-third.

So much for the future. In the pages that follow we present the record of the past, the basis for our optimistic outlook upon the year 1936.

Domestic Air Transport

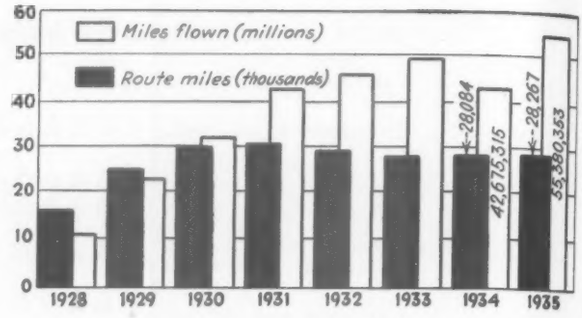
PASSENGER traffic up 68 per cent! Mail traffic up 68 per cent! Express up almost 80! Nowhere in the already honorable statistical history of domestic air transport can be found such a year of progress as 1935 turned out to be.

The period's improvement over preceding years was general not only by types of traffic, and geographical distribution, but by company as well. The "big four," United, TWA, American and Eastern, once more made off with the bulk of the business, some 87 per cent of each type of traffic. But a number of the smaller lines also made big gains—Central, Pennsylvania, Braniff, Western Air Express, National Parks, Wyoming and several others reporting increases well ahead of the national average. Among the big four, American's reported figure of 196,523 passengers carried in 1935 compared with 103,745 in 1934 was spectacular. United, however, still maintained its traffic leadership of the country carrying 31 per cent of the passenger traffic, 41 per cent of the mail, some 52 per cent of the express.

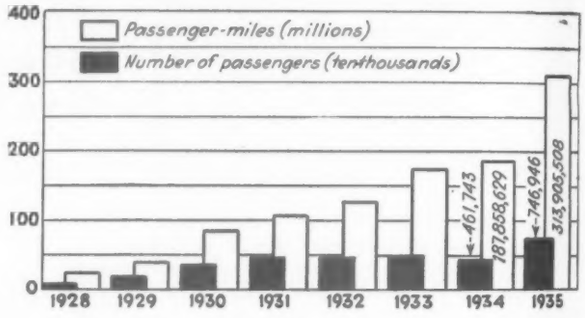
The trend continued toward operations with combined cargoes of passengers, mail and express. All but five of the 23 leading operators held mail contracts; all 23 carried express. Mileage flown by companies without mail contracts amounted to only 2 per cent of the national total. Mileage flown with passengers and express only represented but 28 per cent of that done by companies holding air mail contracts from the Post Office.

To attract the new traffic the airlines offered more frequent service, flying some 30 per cent more miles than they had in 1934 although the total route mileage remained practically constant at the "nearly 30,000" mile level it has held since 1929.

In addition they added 43 new high-performance transports to their fleets to replace obsolescent equipment and to bring



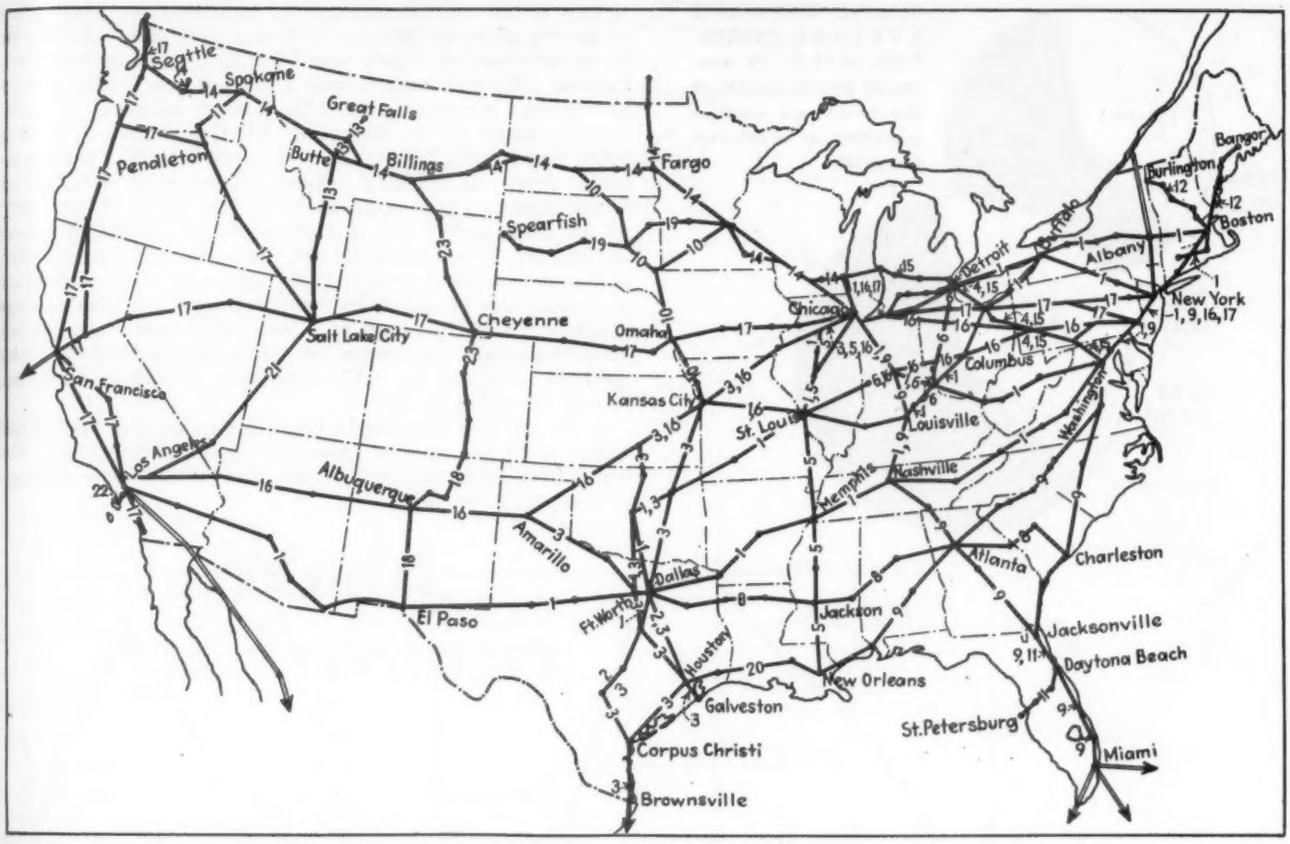
ROUTE MILEAGE AND MILES FLOWN. The former remains constant, the latter reaches an all time high.



PASSENGERS CARRIED AND PASSENGER-MILES FLOWN. Both are new all-time records.

RECORD OF THE AIRLINES FOR 1935

	Operator	Route Miles	Miles Flown	Passengers	Pass.—Miles	Express (lb.)	Express (lb.-mi.)	Mail (thousands of lb. mi.)	Mail Income ($)	Douglas	Boeing 247D	Boeing 247	Condor	Lockheed Electra	Vultee	Stinson A	Stinson U	Stinson SM	Other Lockheeds	Other Boeings	Fleetster	Stearman	Ford	Misc.	Total
1	American Airlines	6,436	10,902,075	196,523	73,571,786	599,642	299,875,929	1,079,004	1,967,039	16				12		8	6	5				7	4	1	59
2	Bowen Air Lines	541	690,109	9,070	2,558,566	10,577	3,396,251	.....	.....						2				2						4
3	Braniff Airways	3,616	2,176,775	13,498	3,691,867	96,150	55,093,029	256,335	423,788					7					6				2	4	19
4	Central Airlines	469	941,986	11,604	2,526,278	112,352	19,212,766	78,879	256,096							5									5
5	Chicago & Southern Air Lines	892	962,942	6,201	1,706,138	40,173	16,860,640	51,720	272,292										6				1	2	9
6	Columbia Airlines	606	150,325	984	194,704	5,857	1,185,150	.....	.....								5								5
7	Consolidated Airlines	80	62,496	1,388	98,280	182,249	13,122,928	.....	.....															2	2
8	Delta Air Lines	1,095	990,604	6,834	1,646,846	8,110	2,243,766	51,162	260,193					2		1		6	2			1			12
9	Eastern Air Lines	3,072	5,684,868	87,389	38,393,481	195,001	135,264,937	727,960	1,150,805	14			8	5										5	32
10	Hanford Airlines	852	723,697	4,274	1,054,927	29,239	5,609,949	25,821	199,682										4	2		1	3		10
11	National Airlines System	237	187,541	887	174,107	3,615	734,164	7,075	37,841								1	2							3
12	National Airways	441	265,142	6,895	951,757	5,796	756,829	3,076	85,383									5							5
13	National Parks Airways	483	536,148	4,081	1,098,135	13,803	4,323,319	24,188	178,675		1	1								2				1	5
14	Northwest Airlines	2,079	2,780,079	28,154	10,342,733	72,272	36,258,466	316,740	613,221					12									1	7	20
15	Pennsylvania Airlines	728	1,605,325	44,855	7,727,171	93,389	15,373,397	3,058	55,208			5											4		9
16	Transcontinental & West. Air	3,407	8,444,691	75,624	62,245,821	254,971	342,534,635	2,006,913	1,483,572	27											6		10	1	44
17	United Air Lines	4,731	15,600,434	201,338	98,655,886	1,723,160	1,135,892,475	3,420,493	3,033,918		44									37			1		82
18	Varney Air Transport	519	382,151	673	204,151	2,235	698,902	10,749	105,801										4						4
19	Watertown Airways	559	92,412	270	90,068	4,008	182,467	.....	.....															2	2
20	Wedell-William Air Service	329	265,379	1,528	393,000	2,683	781,930	11,061	66,233										4					3	7
21	Western Air Express	702	1,212,871	15,133	5,107,921	198,389	82,970,698	167,646	282,471		4	1										1			6
22	Wilmington-Catalina Airline	31	116,988	22,672	614,433	133,280	3,535,966	.....	.....															2	2
23	Wyoming Air Service	579	557,229	6,481	832,016	27,489	3,543,512	21,237	150,845		1								2	2				6	11
	Total	28,267	55,332,267	746,356	313,410,560	3,814,540	2,179,452,105	8,263,117	10,623,063	57	50	7	20	26	10	12	11	19	24	43	6	11	25	36	356



DOMESTIC AIR LINE MAP. The principal scheduled air-lines and their routes are given here. Key numbers refer to the table of traffic, income, and equipment on the opposite page.

block-to-block schedules above 150 m.p.h. on some 24,000 out of the total 28,267 miles of the airway system.

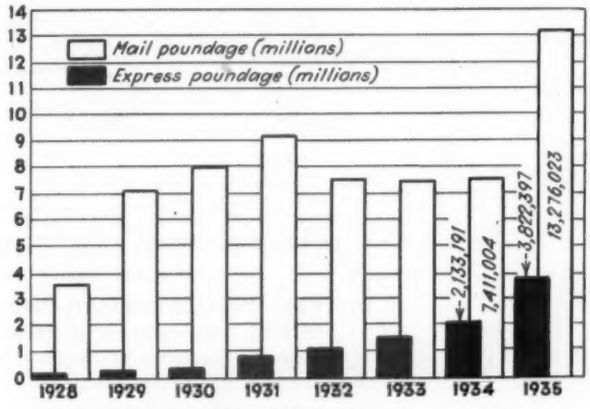
New achievements in safe operation which set new all-time high of 20,927,034 passenger-miles per passenger fatality did much to justify the increased public patronage.

More significant than any other possible statistics, domestic air transport passed during 1935 from the status of a business of great future potentialities but large current deficits to that of an industry with reasonable prospects of paying its own way. The annual statements of the big four are much to the point: TWA reported an actual profit, $19,404 (1934 deficit $407,702); United a loss of only $1,393 (1934 deficit $2,283,525); Eastern a loss of only $13,835 (1934 deficit $692,004); American alone showed substantial loss but even it reported less than half of its previous year's losses ($1,371,392). The chart on the next page showing the average estimated income per mile for all companies together likewise shows an income almost exactly equal to the cost of operating modern airline equipment.

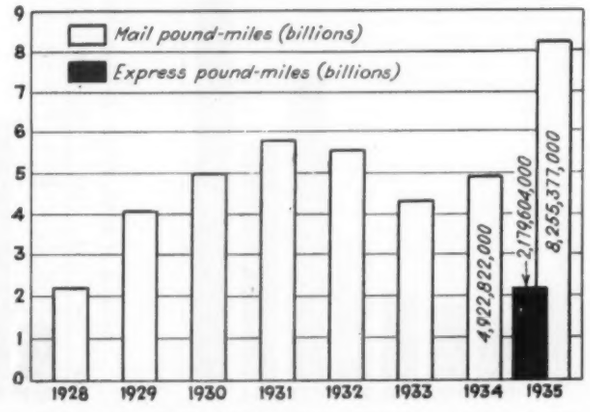
Significant, too, is the rapid convergence of the Post Office air mail income and its payment to air mail carriers. No surer guarantee for future freedom from political meddling could be found than the eventual elimination of any margin between those two quantities.

For 1936 the airlines look for even better traffic. Many are still adding new equipment. Much bigger planes are in prospect for several routes with the heaviest traffic. Unified express, scrip books that reduce the average cost per mile substantially below 1935's 5.7 cents, a continued business upturn, new cheap airsurance for commercial travelers—all these promise enough additional traffic to put the airlines on a definitely paying basis.

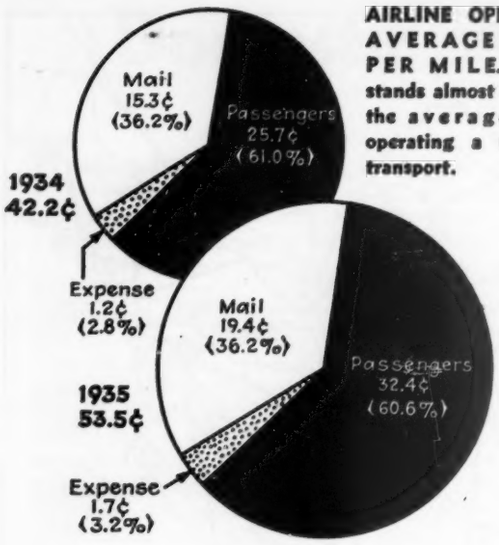
Specific estimates of 1936 traffic volumes are difficult to



MAIL AND EXPRESS POUNDAGE. In a period of five years air express has gone from 8.7 per cent of the country's air mail total to almost 29 per cent.



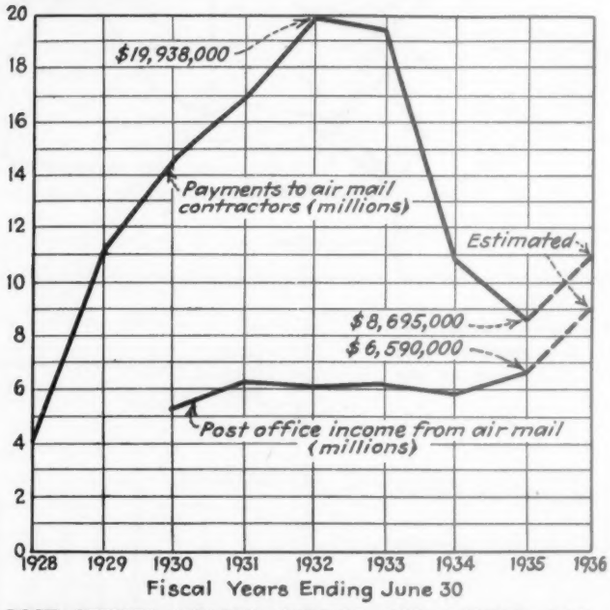
MAIL AND EXPRESS POUND MILEAGE. Mail traffic last year broke all bounds, up some 67 per cent.



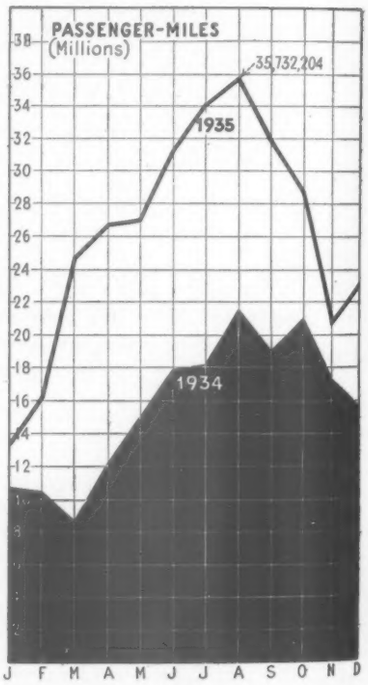
AIRLINE OPERATOR'S AVERAGE INCOME PER MILE. It now stands almost exactly at the average cost of operating a modern transport.

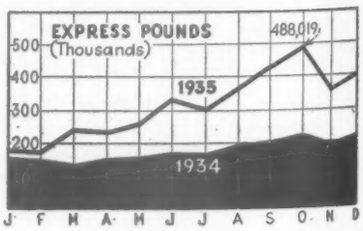
justify in the light of the proven unpredictable past. Part of the big margins between 1935 and 1934 were attributable to the wrecking of 1934's record by the airmail cancellations. Instead, 1936 will have to beat a bumper year. One feather in the wind is certainly the 1936 January summary of traffic recently issued by the Bureau of Air Commerce. It showed miles flown 4,245,199; passengers carried 44,061; passenger-miles flown 18,982,807; express pound-miles 195,295,810. Those figures stand respectively 31 per cent; 57 per cent; 41 per cent; and 73 per cent above the corresponding figures for January, 1934. January, 1934, remember, was a precancellation month. The January, 1936 figures showed an average passenger trip of 431 miles compared with the 1934 average of 406 and a 1935 average of 419—another encouraging index. Related figures: the average air mail letter travelled 672 miles in 1934, only 620 in 1935. The average express shipment moved 570 miles in 1935.

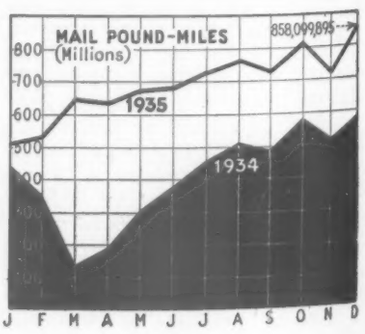
A 30 per cent increase in passenger-miles, and mail-pound miles, a 40 per cent increase in express pound-miles. We set it here as a tentative attempt at a conservative estimate of this year's progress.

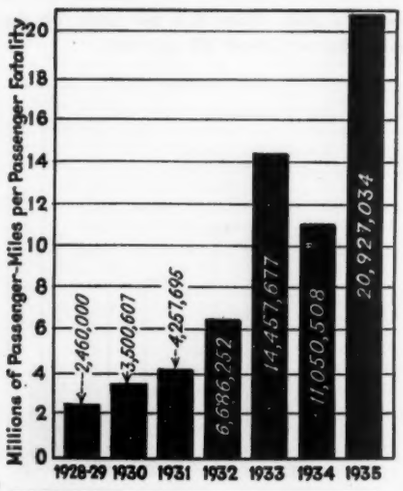


POST OFFICES AIRMAIL INCOME AND CARRIER PAYMENTS. Convergence of these two curves should promise ultimate guarantee of freedom from political foot balling.

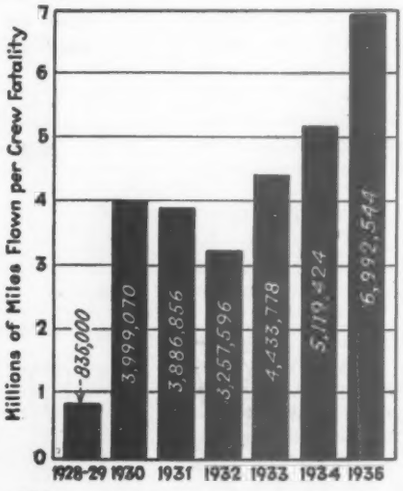




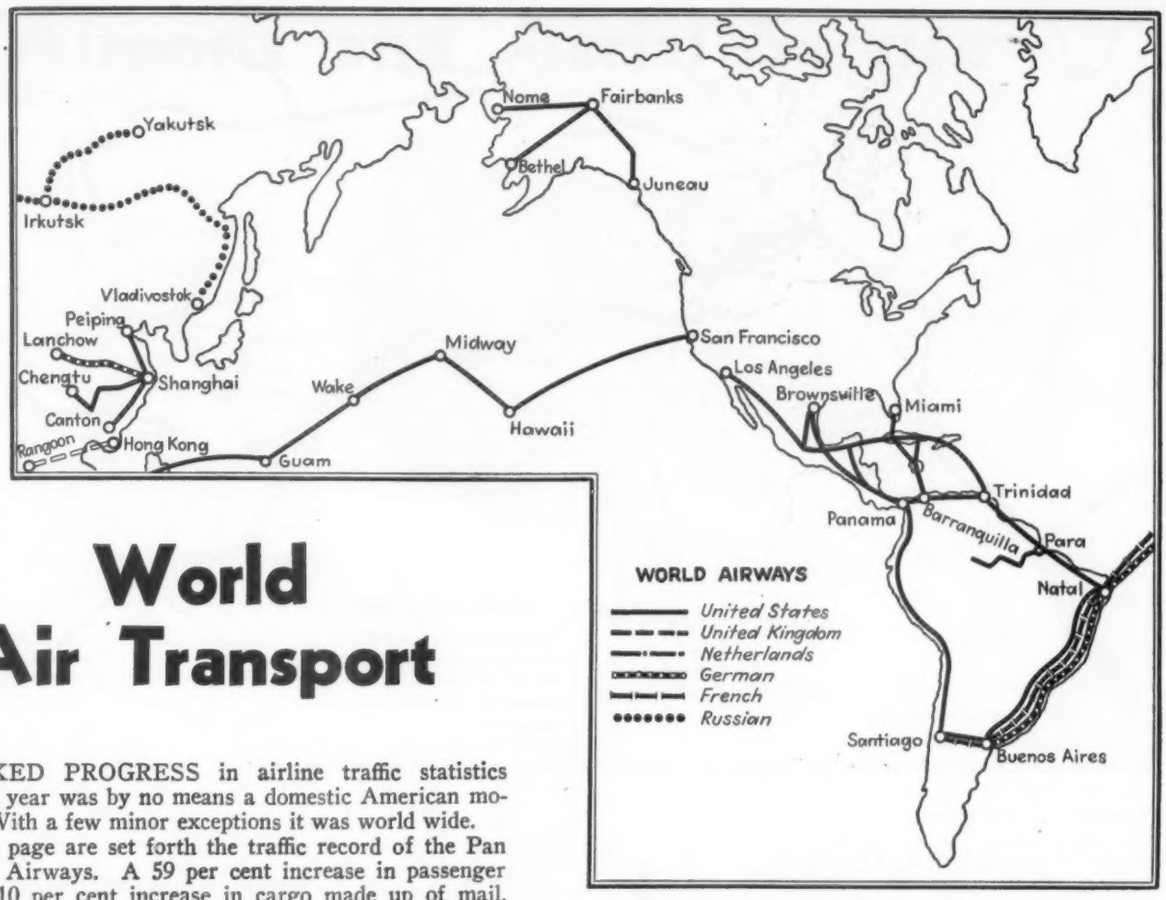




PASSENGER SAFETY IN SCHEDULED TRANSPORT. A new all-time high.



CREW SAFETY IN SCHEDULED TRANSPORT. Another all-time record.



World Air Transport

MARKED PROGRESS in airline traffic statistics last year was by no means a domestic American monopoly. With a few minor exceptions it was world wide.

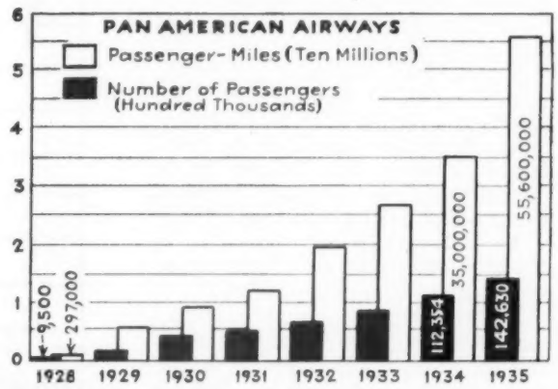
On this page are set forth the traffic record of the Pan American Airways. A 59 per cent increase in passenger travel; a 10 per cent increase in cargo made up of mail, express, and excess baggage. The improvement is only a small fraction less spectacular than that registered on the domestic airways.

Here again the operator flew more miles (10 per cent), bought new equipment, bettered schedules. But the route-mileage remained practically constant (the increase shown on the chart represents the mileage of the San Francisco-Manila route opened in late November).

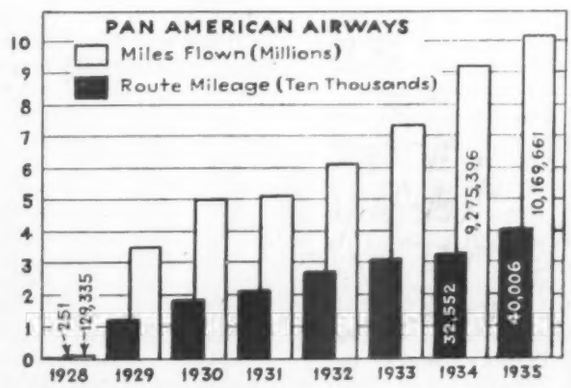
Here also more new equipment, better general business conditions, and improved services promise substantial gains for the coming year.

Nov. 1, Pan American set up new schedules based on 150 m.p.h. for its entire system—an improvement that will reflect more in 1936 figures than in last year's. The trans-Pacific addition alone will do much to swell flying and cargo figures.

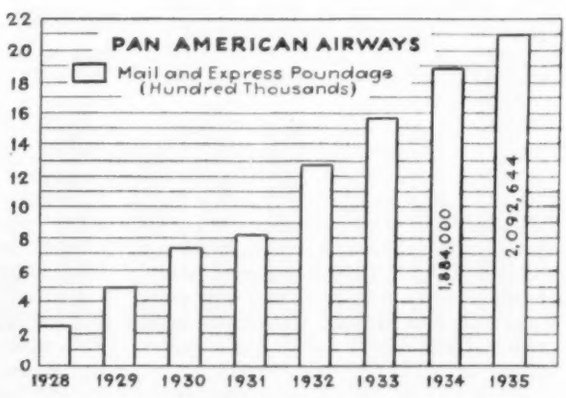
In 1935 not a single passenger fatality was recorded on the entire airline—the third such clear year Pan American



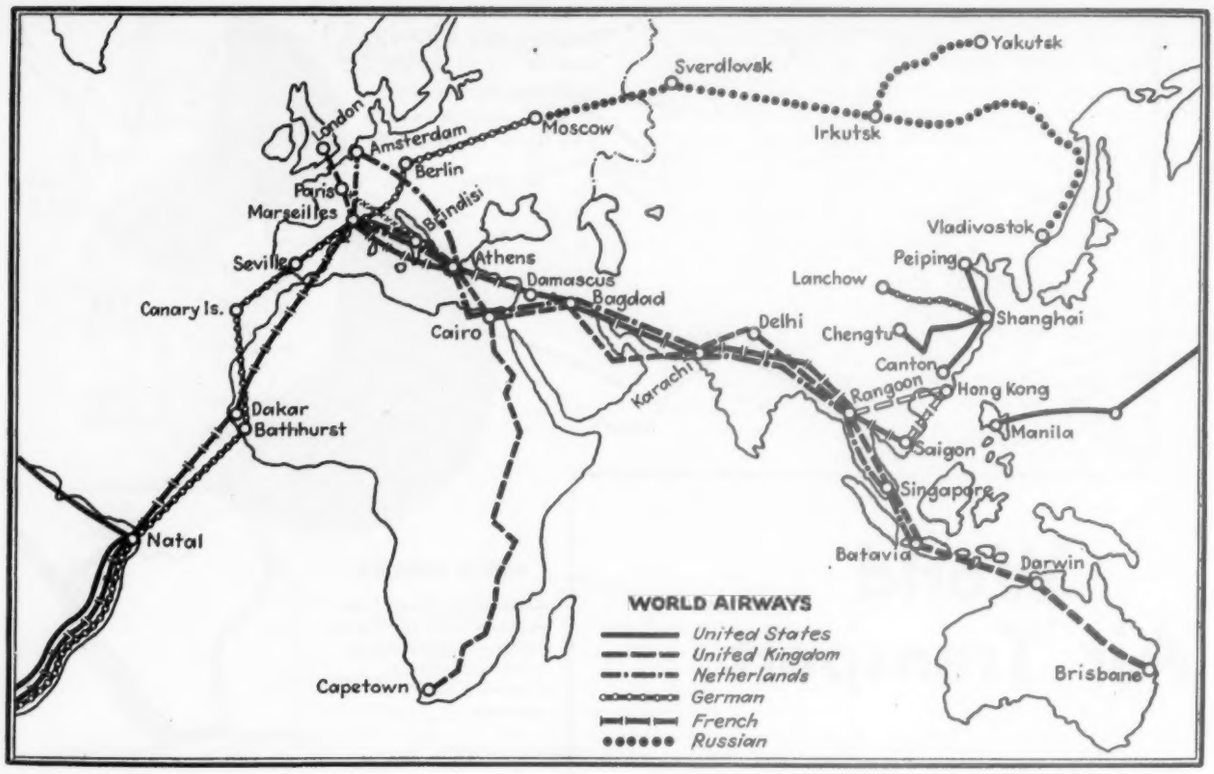
PAN AMERICAN PASSENGER TRAFFIC. 27 per cent more passengers fly 59 per cent more passenger-miles.



PAN AMERICAN OPERATIONS. The new trans-Pacific line jumps route mileage almost 25 per cent.



PAN AMERICAN CARGO. Up 10 per cent over 1934. Includes excess baggage.



has scored in eight years of its history.

Two other companies, Canadian Colonial (An American affiliate) and Seattle-Victoria Air Mail, Inc., last year operated under Foreign Extension Air Mail contracts. Together they flew 210,333 miles, carried 2,519 passengers, logged 629,135 passenger-miles. In the Hawaiian Islands, Inter-Island Airways flew 327,465 miles, carried 13,355 passengers and 24,049 lb. express, flew 1,801,489 passenger-miles.

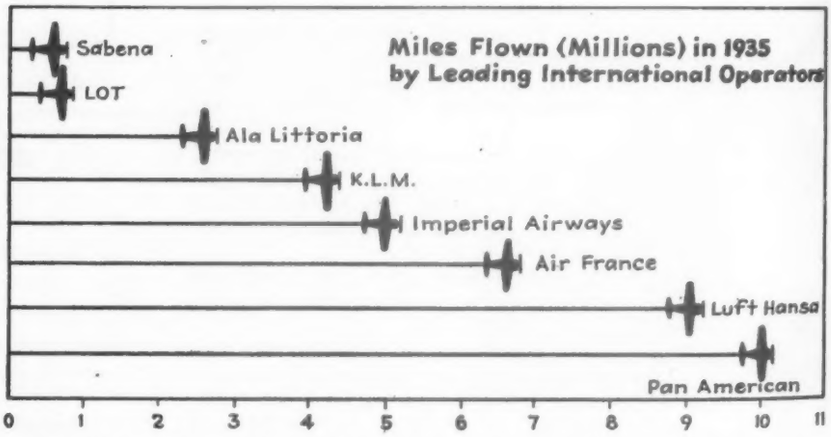
Air transport systems operating in countries other than the United States set up an excellent record in 1935.

Unfortunately full traffic statistics for the various lines are not yet available for enough lines to permit tabulation. Below are listed what data we have been able to secure.

Imperial Airways, for nine months April to Dec. flew 1,983,304 miles in 1934; 3,386,488 miles in 1935. During the same period they logged 2,550,054 ton-miles in 1934; 3,810,535 in 1935 counting passengers, mail and express in the cargo weight.

K. L. M. and affiliated Netherland services carried 100,196 passengers compared with 85,969 in 1934, and 2,910,072 lb. of express compared with 2,344,892. On the Amsterdam-Batavia service alone letter mail increased from 103,110 lb. to 138,890 lb.; parcel post from 6,808 lb. to 7,716 lb.; express from 40,161 to 55,566. Passengers increased from 878 to 1,540, passenger-miles from 2,714,680 to 4,750,603.

S.A.B.E.N.A., the Belgian company with routes in Europe and Africa, last year flew 781,614 miles, carried 536,007 ton-miles of cargo, logged 3,941,922 passenger-miles. Corresponding figures for 1934 were 718,314 miles, 331,017 ton-miles, 2,431,184 passenger-miles.



ESTIMATE OF 1935 TRANSPORT FLYING BY INTERNATIONAL OPERATORS. Mileage assigned Air France, Imperial, Luft Hansa, and Pan American include estimates for affiliated operations.

Italian lines led by Ala Littoria carried 45,447 passengers, 2,107,889 lb. of cargo and flew 2,281,993 miles in the first nine months of 1935. During the whole of 1934 they flew 2,736,050 miles, carried 40,930 passengers, 2,109,524 lb. of cargo.

L.O.T., the Polish Line, flew 1,065,999 miles in 1934; 848,488 in 1935. Passengers carried in 1934 totalled 18,198; in 1935, 18,086. Baggage and freight totalled 799,726 lb. in 1934; 799,190 in 1935. Mail rose from 105,195 lb. in 1934 to 136,241 lb. in 1935.

Luft Hansa and Deruluft between them last year flew 9,260,000 miles and logged 43,000,000 passenger-miles, 760,000 ton-miles of express and carried 3,100,000 lb. of mail—increases over 1934 of 10 per cent, 15 per cent, 29 per cent and 85 per cent respectively.

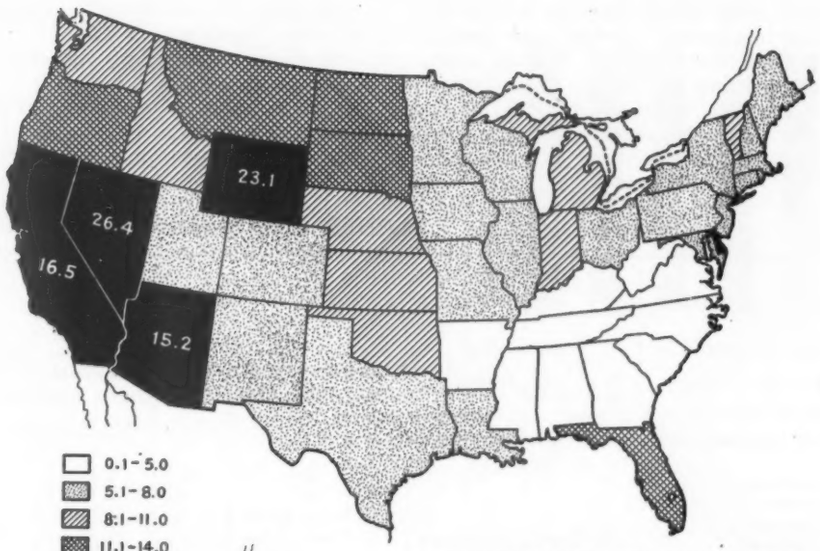
Civil French lines led by Air France, last year flew 6,000,000 miles and logged 20,200,000 passenger-miles, 550,000 ton-miles of express and 376,000 ton-miles of mail. Comparative figures for 1934 were 6,200,000 miles, 15,300,000 passenger-miles, 515,000 ton-miles of express, 355,000 ton-miles of mail. Also there were some army airline operations in Africa.

Airports and Aerial Service

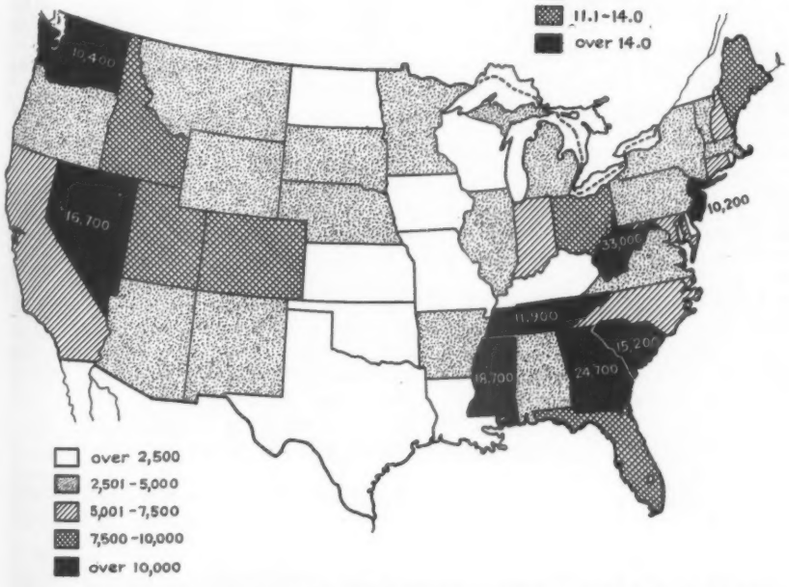
OFFICIALS of CWA, PWA, FERA, and other early relief organizations discovered that airports could not be built by work alone. Like the Old Testament Pharaoh, their programs stopped when workers were required to find not only the bricks but also the straw with which to make them. WPA has set out to remedy all this and has gotten off to a good start. On the basis of activities to date it seems reasonable to expect that at least 25 per cent of the total funds definitely allocated to airport construction will be spent for materials.

In the early months of 1936, the WPA airport program was as well under way as weather and the discretion of State Works Progress administrators permitted, for without the approval of the neighborhood representatives of Harry Hopkins, the best laid plans of sponsors, National WPA officials, and Air Commerce Bureau inspectors can be of no avail.

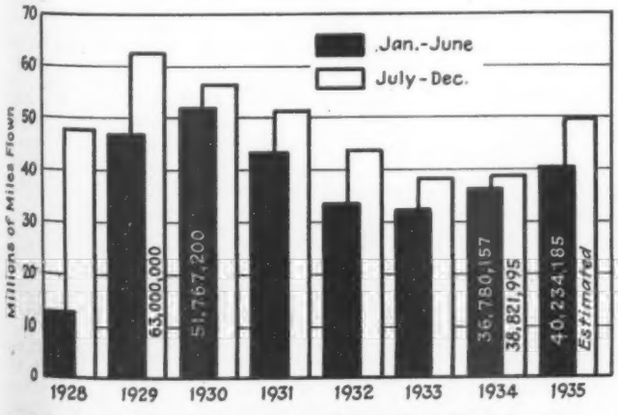
Up to Feb. 15, a total of 410 airport and airway projects had been released by local WPA administrators. Of these 325 were under construction and 25 had been completed. Funds totaling $21,090,965, of which $3,000,000 was contributed locally, are involved. These projects have been selected



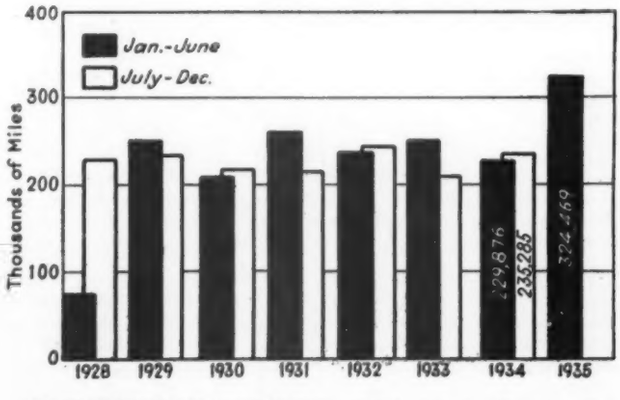
LICENSED PLANES PER 100,000 POPULATION. Sparsely populated states and those in which a large number of ships are licensed by airlines give a somewhat misleading impression in this type of treatment. Discounting Arizona, Nevada, and Wyoming, for this reason, California leads in aeronautical activity.



BUREAU OF AIR COMMERCE APPROVALS FOR WPA AIRPORT DOLLARS PER LICENSED PLANE. Large concentrations of WPA airport allotments crop up in unexpected places.



MILES FLOWN IN MISCELLANEOUS OPERATION. Now we are back approximately to the 1931 mark.



MILES FLOWN PER FATALITY. Safety in miscellaneous flying is also on the upward trend.

locally from the 1,400 involving $110,172,828 so far approved by WPA headquarters in Washington.

Materials purchased for construction work include lighting and drainage equipment, paving and hangar construction materials, fencing, paint, and grading machinery. Some indication of the volume of material necessary for this work is given by the following breakdown of the 410 projects at present completed or underway:

40 require purchase of lighting equipment.

39 require construction of hangars and other buildings.

50 require paving of runways or aprons.

15 require major painting jobs but almost all will require paint.

10 require oil for runways.

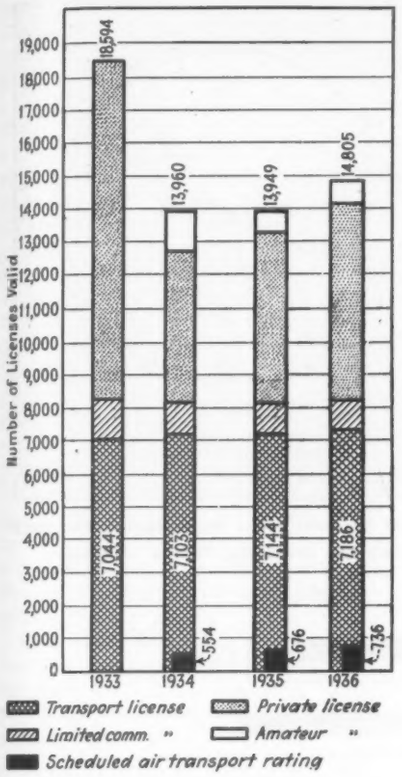
41 require drainage equipment.

15 require fencing.

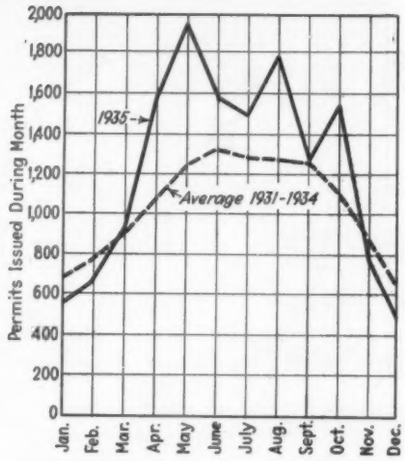
The accompanying map showing the geographical distribution of WPA airport funds indicates that certain states have been slow in accepting the opportunities offered by the program while others (some of which have only small numbers of licensed planes in operation within their borders) have received more than their full

PLANES, PILOTS, PORTS AND PROJECTS

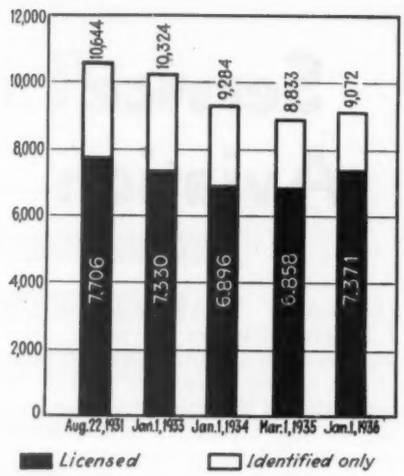
State	Aircraft			Pilots					Airports								WPA Airport Projects	
	Licensed	Unlicensed	Total	Transport	Limited commercial	Private	Amateur	Total	Municipal	Commercial	Intermediate	Auxiliary	Navy	Army	Miscellaneous	Total	Number	Amount Approved by Bureau of Air Commerce
Alabama	39	29	68	71	4	50	4	129	6	3	7	11	0	3	0	30	11	236,232
Arizona	55	12	67	34	5	55	9	103	11	4	10	19	0	1	1	46	9	294,476
Arkansas	45	15	60	54	3	29	1	87	16	2	5	8	0	0	0	31	19	244,149
California	831	103	934	1,118	107	1,226	159	2,611	51	49	20	52	4	5	11	192	50	5,244,055
Colorado	52	15	67	44	7	29	7	87	12	4	2	16	0	1	0	35	23	629,730
Connecticut	103	1	104	88	15	115	11	229	7	6	1	4	0	0	2	20	7	575,368
Delaware	41	1	42	13	0	20	0	33	1	1	0	2	0	1	0	5	0	.....
District of Columbia	101	8	109	147	7	75	2	231	0	1	0	0	1	1	0	3	1	70,000
Florida	152	43	195	219	10	136	15	380	42	17	3	36	5	1	3	107	80	1,777,973
Georgia	67	43	110	71	6	48	4	129	19	2	12	14	0	1	0	48	30	2,718,565
Idaho	35	5	40	24	9	15	5	53	21	0	10	15	0	0	9	55	25	378,192
Illinois	517	44	561	440	47	378	41	906	15	32	6	1	1	2	2	59	7	2,684,715
Indiana	186	104	290	140	24	141	20	325	13	16	8	4	0	2	2	45	10	1,777,636
Iowa	146	39	185	89	13	86	0	188	16	10	3	7	0	0	1	37	4	101,101
Kansas	123	84	207	107	11	59	9	186	23	5	5	10	0	2	0	45	12	337,932
Kentucky	51	14	65	38	2	26	3	69	8	0	3	9	0	1	0	21	1	20,778
Louisiana	92	14	106	100	6	51	11	168	9	3	3	10	0	1	2	28	4	128,252
Maine	55	8	63	32	4	17	1	54	4	8	0	13	0	0	1	26	24	516,124
Maryland	81	25	106	78	10	82	6	176	2	9	2	0	1	3	3	20	3	668,864
Massachusetts	198	24	222	172	28	196	34	430	5	27	1	7	1	0	1	42	13	803,513
Michigan	299	96	395	283	31	222	44	580	46	14	0	19	1	3	34	117	77	1,370,194
Minnesota	134	53	187	155	28	38	11	232	10	5	3	14	0	1	1	34	10	766,547
Mississippi	57	7	64	21	4	23	1	49	12	0	6	6	1	0	1	26	41	1,194,509
Missouri	175	63	238	268	14	111	9	402	11	6	13	5	0	0	3	38	14	384,348
Montana	53	18	71	37	9	42	4	92	27	0	14	27	0	0	10	78	43	308,767
Nebraska	84	51	135	77	10	56	11	154	17	3	5	5	0	2	0	32	3	501,597
Nevada	15	9	24	7	1	8	3	19	3	2	9	7	1	0	0	22	8	401,607
New Hampshire	27	7	34	15	7	18	3	43	5	4	0	10	0	0	1	20	9	221,274
New Jersey	206	28	234	240	21	191	22	474	4	19	0	1	2	2	1	29	4	2,393,394
New Mexico	21	7	28	14	3	10	1	28	6	4	10	12	0	0	2	34	9	106,984
New York	887	50	937	583	131	648	81	1,444	27	43	5	15	0	4	5	99	17	3,942,648
North Carolina	73	51	124	47	3	39	5	94	12	6	3	8	0	1	0	30	14	700,963
North Dakota	58	28	86	42	2	26	2	72	20	3	5	18	0	0	1	47	6	50,498
Ohio	395	76	471	355	78	333	43	809	28	36	9	21	0	4	5	103	34	3,539,141
Oklahoma	177	37	214	124	14	109	17	264	23	6	7	12	0	1	0	49	5	275,691
Oregon	77	53	130	71	7	89	15	183	13	3	10	11	0	0	2	39	37	418,591
Pennsylvania	499	66	565	290	75	385	41	791	12	68	12	13	1	2	9	117	12	2,223,204
Rhode Island	37	1	38	20	2	29	2	53	0	4	0	3	1	0	1	9	1	53,546
South Carolina	26	28	54	33	7	12	1	53	10	2	4	9	3	0	2	30	12	823,317
South Dakota	69	10	79	35	11	46	5	97	17	5	0	4	0	0	0	26	8	222,736
Tennessee	93	24	117	80	4	95	3	182	12	2	5	5	0	0	0	24	6	1,398,894
Texas	325	138	463	459	37	201	26	723	56	9	25	28	0	13	3	134	27	992,826
Utah	33	5	38	41	5	20	2	68	5	1	16	2	0	0	0	24	17	376,935
Vermont	36	1	37	13	4	11	3	31	4	4	0	2	0	1	0	11	5	107,368
Virginia	89	24	113	188	14	70	2	274	12	9	5	14	2	1	0	43	15	409,974
Washington	126	27	153	153	21	118	18	310	21	10	9	6	1	3	2	52	33	1,601,061
West Virginia	54	10	64	37	9	38	9	93	8	4	0	9	0	0	1	22	6	1,916,880
Wisconsin	148	82	230	104	29	67	13	213	22	21	5	8	0	0	3	59	10	425,280
Wyoming	37	15	52	34	2	10	2	48	14	0	10	19	0	0	0	43	12	222,205
Total	7,280	1,696	8,976	6,905	901	5,899	741	14,447	738	492	291	551	26	63	125	2,286	793	46,508,624



PILOTS LICENSES BY YEARS. Private licenses lead all other categories in growth in 1935.



SEASONAL TREND OF STUDENT PERMITS ISSUED. The peak came earlier in 1935 than in four previous years.



LICENSED AND IDENTIFIED PLANES. Licensed planes have grown in 1935 at the expense of those only identified.

share of the allotments. The relatively low density in volume of allotments in states having important transport airports indicates that the program has not yet accomplished its previously announced purpose of giving first attention to key points on the airline map.

As to the final total of funds to be expended on the program there is much latitude for speculation. One thing seems reasonably certain. Weather, floods, tornados, and local conditions of various sorts will make it difficult, if not impossible, to complete the program on schedule and it is likely that some extension of time will be arranged. It is also conceivable that the final total of allocated funds will be considerably larger than previous estimates have indicated. Projects approved by the Air Commerce Bureau to date, given in the last column of the table on page 74, may be considered as an approximate goal.

Mileage flown in miscellaneous operations during the first half of 1935 reached 40,234,185, the highest level since 1931. Passengers carried were 556,332 in number. Although figures for the last half of 1935 are not yet available, estimates indicate that substantial increases may be expected in each of the following categories of miscellaneous operation:

Instruction, 53 per cent.

Cross-country, sightseeing, advertising, dusting, photography, etc., 29 per cent.

Pleasure, 8 per cent.

Experimental, exhibition, demonstration, competition, 98 per cent.

Business (non aeronautical), 18 per cent.

Major gains are indicated in the subdivisions including instruction and demonstration flying, which form the foundation for future private flying activity.

Fixed base services other than instruction have shown a healthy increase which may be attributed to increased charter and sightseeing activity resulting from improved conditions in business generally and to more general use of airplanes in agricultural and survey functions for crop control and public works projects. Most significant for the manufacturers and distributors of airplanes is the rising activity of airplanes used in non-aeronautical business. After three years of stability this figure for 1935 has far surpassed the mark for 1931.

Although the safety of non-scheduled commercial flying in 1935 soared to heights never before attained, there is still plenty of room for improvement when comparisons are made with the record of the airline operators. Statistics show that it is safer to ride in a scheduled airliner than it is to go for a jaunt in the family automobile, but the family airplane, if such a thing may be said to exist, is in quite a different category. On the average it is only one fifteenth as safe as the scheduled airliner or the automobile. This is not an indictment of the private airplane or the responsible charter or sightseeing operator who is doing comparatively well. But these people are being penalized as the direct result of carelessness, poor judgment, unnecessary acrobatics and general violation of the Department of Commerce regulations. According to recent accident studies, one-half of the accidents in miscellaneous and pleasure flying are due to pilot errors, one-third to careless flight instruction, and only 10 per cent to bad weather. Further substantial improvements in the safety of miscellaneous flight may be expected from the recent efforts of the National Association of State Aviation officials and certain aircraft manufacturers to cooperate with the Air Commerce Bureau in its work to eliminate the unnecessary hazards of flight.

Acknowledgment

IN the preparation of this material on the progress of aviation it has been necessary to call upon many organizations and individuals for cooperation in furnishing the many separate bits of data that are pieced together in order to reach the conclusions presented here. We have availed ourselves of the aid of agencies and persons too numerous to mention individually but we wish to make special acknowledgment for assistance derived in securing the material for our studies from the Bureaus of Air Commerce and of Foreign and Domestic Commerce of the Department of Commerce; from the Aeronautical Chamber of Commerce; from the Post Office, War, and Navy Departments; and from the National Aeronautic Association. To them, and to others in the Americas and in Europe, we express our appreciation for their participation in making this issue possible. No acknowledgment would be complete without mention of the assistance given us by Edward P. Warner, formerly editor of AVIATION.

Service Aviation

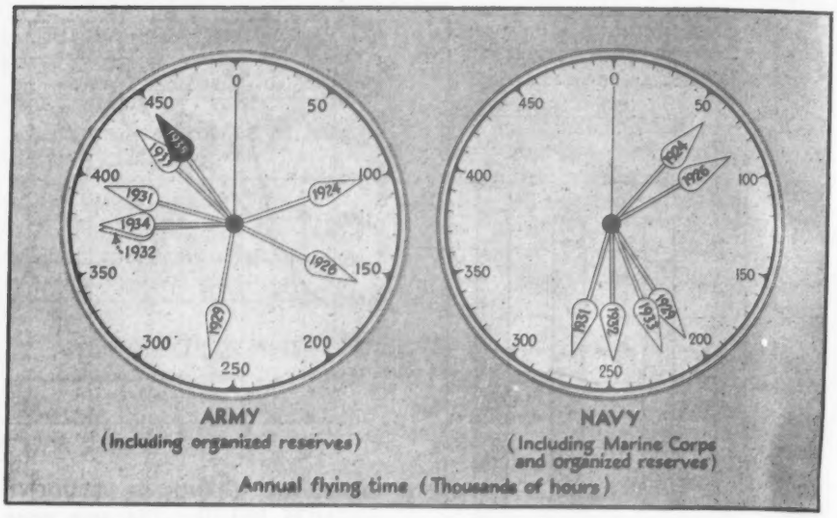
IN LAST YEAR'S Record of Progress Number we wrote, "For the American air forces, the big news of this or any other year is that the population of the halls of government has at last attained to a unanimous understanding that a modern air force costs money and that one cannot be created simply by passing a law about it."

We can hardly do better than to head this comment on 1935 developments with the remark that the unanimous understanding granted to Congress in 1934 has been not only retained but even further developed. For the fiscal year ending June 30, 1935, the two branches of our air arm had $65,000,000 available between them in direct appropriations. For the fiscal year of 1936 they have had $91,000,000. Appropriation bills about to emerge from the present session of Congress up the Air Corps appropriation another $14,000,000 above its 1936 $50,000,000 and add a corresponding increase to the Navy's figure.

Although there have been substantial increases in appropriations for new equipment, they have been reflected but poorly in the accompanying chart of planes on hand. Actual delivery of new units to the Air Corps in 1935 was practically at a standstill but the years development work began to bear fruit early in 1936 and important contracts were forthcoming, including: Northrop, 210 attack ships; Douglas, 90 twin-engined bombers; and Boeing, 13 four-engined bombers of the 299 Model. Navy procurement in 1935 was marked by the letting of a number of contracts, one to Consolidated for 60 long-range patrol boats costing $8,500,000, the largest single ship order ever placed in peace time. Second largest Navy order of the year went to Curtiss-Wright for scouts.

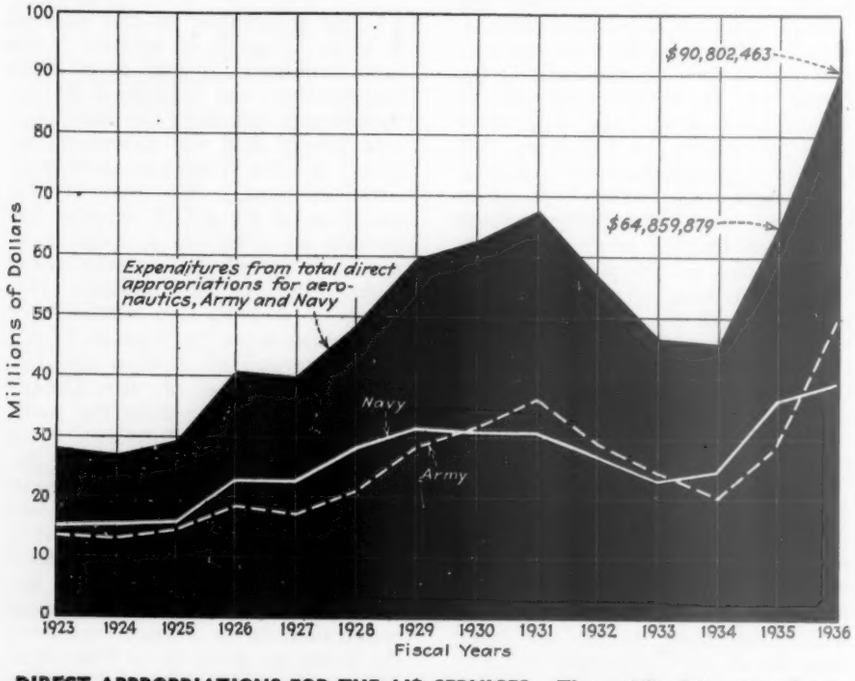
A large part of this money has gone, of course, into the extensive aircraft procurement programs as related in the section on Production and Export. But large sums have also been available for unprecedently extensive flight operations, in both services.

The Air Corps year was marked by



TIME IN THE AIR. The Air Corps flew 20 per cent more hours during the fiscal year ending June 30, 1935 than it did during the preceding twelve months.

FLYING EQUIPMENT OF AIR FORCES. Both arms continue their emphasis on service types. Both hold almost stationary as obsolescence absorbs new procurements.



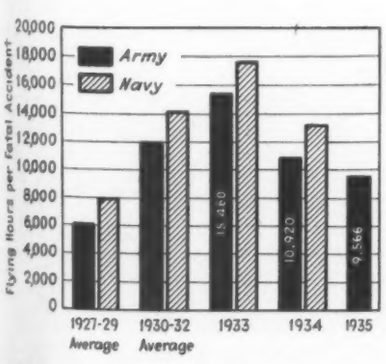
DIRECT APPROPRIATIONS FOR THE AIR SERVICES. The rapidly rising cost of our air defenses. "Indirect" appropriations more than double these expenditures.

several advances not amenable to statistical treatment. First in importance the GHQ airforce was set up early in January, and gave the service a freedom for tactical development it has asked for since the Armistice. As a result comparatively large groups of combat craft undertook extensive maneuvers in various parts of the country of a type hardly possible under previous set-ups. Few measures have ever had so good an effect on air force morale. Second, the passage of the Wilcox Bill during the summer gave the Corps a mechanism by which it can acquire and seek funds from Congress for a system of air bases designed on a definite and modern concept of the country's air defence problems. Chief fly in the Air Corps' ointment still remains that of promotion—beyond much doubt, the 1935 tryout of the temporary-rank plan proved it no big improvement over the slow whole-army system of advancement.

Somewhat disturbing is the Air Corps safety record for the year ending June 30, 1935. The drop of the preceding year over the 1933 figure was partly accounted for by the Corps' grief with the Air Mail. The 1935 figure lacks even that explanation. A larger proportion of flying in high-performance combat types, maneuvers approaching war conditions, more bad weather cross-country attempts seem the underlying causes of the safety decrease.

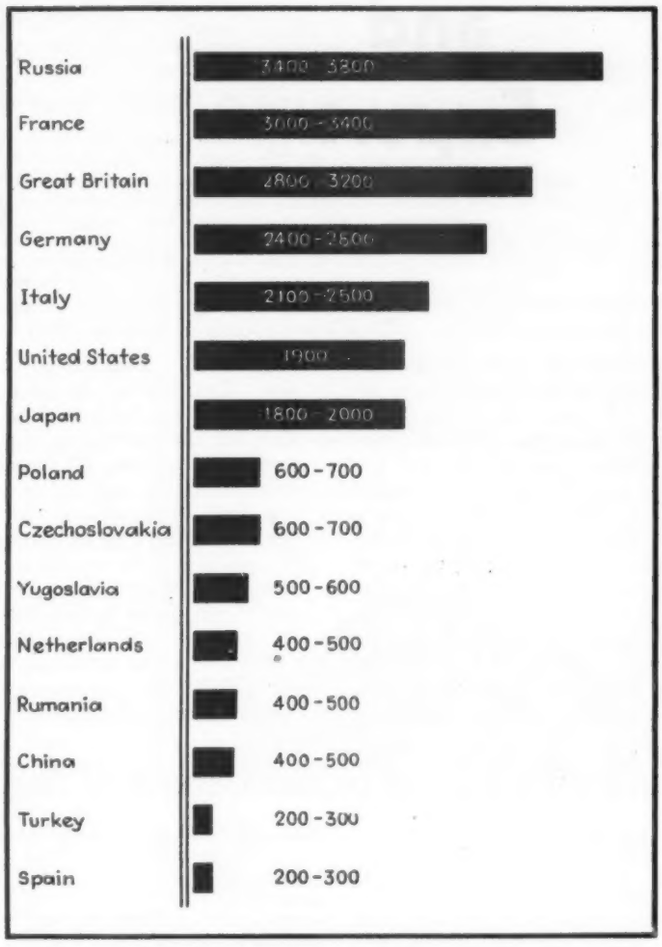
Outstanding developments in the Navy's flying year were the addition of the Ranger to the fleet's active carrier forces, the brilliant part played by the carriers and the patrol boat squadrons in the spectacular Pacific maneuvers, and the cadet program that will add close to 500 to the Service's list of trained pilots.

Incidentally, we must explain here the absence from the accompanying chart of figures for Navy operations and safety for recent years, by expressing our regret that our Navy has gone as mute statistically as mute can be.



SAFETY IN THE SERVICES. The downward trend continues as operating programs embrace more difficult tasks. Recent Navy figures not available.

World Air Power



AIR STRENGTH OF NATIONS. The combined air forces of the United States are on a par with those of Japan and weaker than those of any other major power.

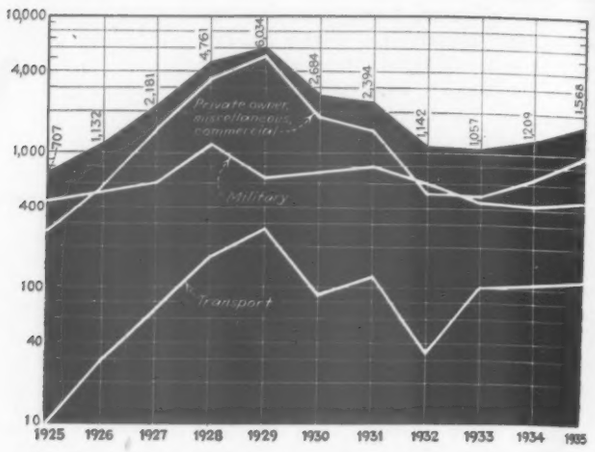
THE making of comparative estimates of the air powers of different nations has become one of the most hazardous of statistical occupations. Our estimate a year ago was made amid difficulty enough. Since then Germany has launched on one of the most extensive programs of air force building in history. France and England have started wide replacements and increases. Italy has been at war for months. Russia has carried on with its ambitious plans but has grown none the less difficult to gage from half a world away. Japan presents equal difficulties.

Meanwhile the argument over what constitutes a "first-line aircraft," an "effective combat plane," or a "reserve" has grown increasingly muddled, pacifists claiming almost anything with wings will be capable of considerable action in the case of hostilities; generals maintaining that no planes in their commands will be worth a tinker's dam save what has been delivered within the past half year.

As a matter of fact most such classifications are quite meaningless without complete specifications of the type of warfare, the opposing forces and the quality of industrial backgrounds involved.

Our own analysis is based on the assumption that the United States possesses 1,900 effective combat airplanes in good repair and that such is our air force. Insofar as we could we have made that our yardstick in judging the forces of other countries. For those who believe this country has only a few hundred serviceable aircraft we suggest a similar scaling down of all countries accordingly.

Production and Export



NUMBER OF PLANES BUILT. All classes of airplane manufacture are upward bound.

ALTHOUGH the number of aircraft produced in the United States for 1935 did not quite reach the levels predicted last year, the trend continues to be definitely upward from the low established in 1933. In both transport and military categories, however, gains were not spectacular. Biggest boost came, somewhat unexpectedly, from the production of airplanes for the private owner.

On the basis of dollar valuation, where a year ago we had anticipated close to $35,000,000 worth of business for 1935, the actual was approximately $22,000,000. Two things account for this. The first was an unexpected rise in demand for light airplanes. Taylor Cub led the production list with 230 units, or just over 20 per cent of the total. But the unit value of Cubs is low and represents far less than 20 per cent of the total in terms of dollars. Biggest lag, however, came in military spending. Where last year it was expected that close to $25,000,000 would be spent for military aircraft during 1935, the actual total came to $11,400,000.

At that, in terms of dollar valuation, the military took over half of the year's output. Last year the distribution ran: military, 47 per cent; transport, 39 per cent; non-transport, 14 per cent. In 1935 the distribution shows: military, 52 per cent; transport, 38 per cent; non-transport, 10 per cent.

During 1935 the center of gravity of aircraft production in the United States shifted somewhat, moving further west. As was pointed out in our February 1936 issue, two important units of the industry, Consolidated of Buffalo and North American of Baltimore, abandoned their former quarters and built new plants at Los Angeles and San Diego respectively. Not only have these two companies established themselves in their new quarters on a more extensive scale than their old, but also the Douglas plant is being materially expanded. The concentration of the industry in Southern California, plus the expansion of plants already there, has resulted in a marked scarcity of expert and mechanical personnel in that district.

NEW AIRPLANE AND ENGINES LICENSED IN 1935

Airplanes Licensed or Identified for First time during 1935	
Aeronca	114
Beech	34
Bellanca	5
Boeing	25
Cessna	6
Consolidated	3
Curtiss-Wright	4
Douglas DC-2	42
Douglas—Others	5
Fairchild—Cabin	85
Fairchild—Open	10
Kinner—Cabin	4
Kinner—Open	4
Laird	3
Lambert	47
Lockheed Electra	30
Lockheed—Others	1
Luscombe	4
Martin	2
North American	2
Northrop	9
Porterfield	48
Wiley Post	2
Rearwin	31
Ryan	11
Seversky	4
Sikorsky	7
Stearman	1
Stinson	69
Swallow	1
Taylor	230
Vultee	11
Waco Cabin	91
Waco Open	12
Miscellaneous	161
Total	1,118

Engines Used in Planes Licensed or Identified for First Time during 1935	
Aeromarine 50 hp	3
Aeronca 36 hp	116
Cirrus	4
Continental 37 hp	231
Continental 210 hp	13
Ford V8	1
Ford—Others	37
Henderson 27 hp	15
Jacobs 225 hp	96
Kinner 100 hp	6
Kinner 125 hp	5
Kinner 160 hp	4
Kinner 300 hp	1
Lambert	31
LeBlond 85 hp	2
LeBlond—Others	85
Lycoming 225 hp	13
Lycoming 245 hp	50
Lycoming 260 hp	7
Menasco 95 hp	4
Menasco 125 hp	9
0x5, 0xx6	6
Pratt & Whitney 400-550 hp	112
Pratt & Whitney 551-700 hp	15
Pratt & Whitney 701-830 hp	31
Ranger 145 hp	21
Szekely	8
Velie 65 hp	5
Warner 125 hp	4
Warner 145 hp	91
Wright Gypsy 90 hp	6
Wright 220-399 hp	43
Wright 400-550 hp	14
Wright 551-800 hp	106
Miscellaneous	50
Total	1,245

Civil aircraft

Considering civil production for the moment, the transport division maintained about the same levels established in both 1933 and 1934. This, of course, was due to continued replacement of obsolete equipment by all the airlines. It marked the end of the Ford era and the rise of the 2-engined all-metal transport, of which the Boeing 247, Douglas DC-2 and the Lockheed Electra are typical. As shown in the table, the latter two models led the transport production in 1935. There were periods last spring when better than two DC-2s a week came off the production line at Santa Monica.

With the virtual completion of the current replacement program by many of the airlines, production of DC-2s has tapered somewhat for domestic consumption, but a number of them are being turned out for overseas ship-

ment. With the DC-3 (DST) now in production, and with numerous orders for this model on the books, 1936 Douglas output should exceed 1935 both in number of units produced and in total dollar valuation. The 4-engined development (see page 45), this issue will not influence production figures until 1937-38.

The Lockheed year was marked by orders for replacements by a number of the airlines, large and small. Also, Lockheed, in common with Stinson, Kinner, Beech, and others has a new model available which should prove popular during 1936, a smaller 2-engined transport for feeder line and local services.

The 25 Boeings shown on the list were not strictly new production. They represent model 247 transports, originally built during 1933-34, but rebuilt and converted to the newer model 247-D (550 hp. Wasp engines) by United Airlines at its Cheyenne (Wyo.) overhaul plant.

Northrop (Gamma and Delta), Stinson (Model A), Airplane Development (Vultee 1-A) and Bellanca (Aircruiser) also produced land type transports. Included on the list also are Martin and Sikorsky, who delivered large flying boat or amphibian transports (Martin 130, Sikorsky S-42A, S-43) to Pan American Airways, and Inter-Island Airways (Hawaii).

For the private owner

In the private owner field unexpected strength developed. Most spectacular was the showing put up by the light, low-horsepower class, including Taylor, Aeronca, Porterfield, and Rearwin. Waco, Stinson, Fairchild, Lambert and Beech turned in good figures for the more expensive types.

Nor are there any signs of slacking off in the private owner market for early 1936. Indications are that all manufacturers of civil airplanes for non-transport use can count on increased business for the spring of 1936.

AIR CORPS PLANE CONTRACTS SINCE DEC. 1, 1934

Dec. 8, 1934 — Consolidated — 51 two-place pursuits — $2,369,281 — Wright Conquerors
Dec. 11, 1934 — Northrop — 110 attack — $1,896,400
Dec. 24, 1934 — Douglas — 71 observation — $1,706,480 — Pratt & Whitney 700 hp.
Jan. 2, 1935 — Seversky — 35 basic training — $754,738 — Wright 350 hp.
Apr. 2, 1935 — Martin — 15 bombers — $652,279 — 2 Wright Cyclones
July 3, 1935 — Stearman — 26 primary trainers — $243,578 — Lycoming 225 hp.
July 19, 1935 — North American Aviation — 42 basic trainers $559,732 — Wright 440 hp.
Sept. 26, 1935 — Douglas — 18 transports — $1,235,000 — two Wright Cyclones.
Dec. 17, 1935 — Northrop — 111 attack — $2,065,550 — Pratt & Whitney 750 hp.
Dec. 21, 1935 — Douglas — 86 bombers — $6,498,000 — two Wright 1000 hp.
Dec. 21, 1935 — Boeing — 13 bombers — approx. $3,250,000 — four Wright 1000 hp.

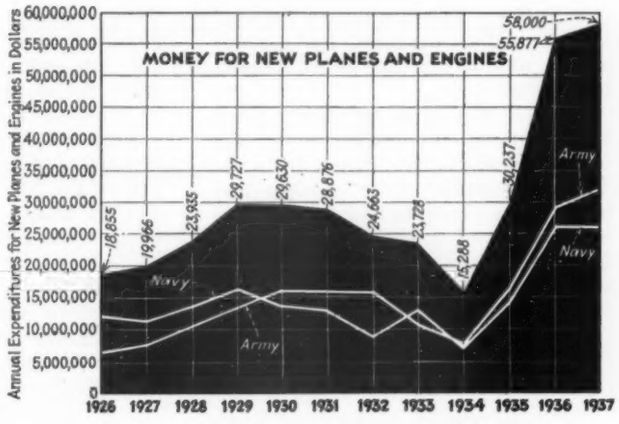
NAVY PLANE CONTRACTS SINCE DEC. 1, 1934

Jan. 5, 1935 — Vought — 84 bombers — $1,804,800 — Pratt & Whitney
Feb. 12, 1935 — Grumman — 11 utility — $287,984 — Wright Cyclone
Feb. 25, 1935 — Great Lakes — 16 bombers — $437,565 — Pratt & Whitney 830 hp.
Mar. 1935 — Curtiss — 135 observation — $2,752,705 — Pratt & Whitney Wasp
Mar. 30, 1935 — Vought — 16 observation — $347,800 — Pratt & Whitney Wasp
June 29, 1935 — Consolidated — 60 patrol — $6,506,000 — two Pratt & Whitney 830 hp.
June 29, 1935 — Grumman — 29 utility — $845,964 — Pratt & Whitney 830 hp.
June 29, 1935 — Douglas — 2 transports — $158,002 — two Wright Cyclones
Jan. 20, 1936 — Douglas — 114 torpedo bombers — $3,636,000 — Pratt & Whitney 830 hp.

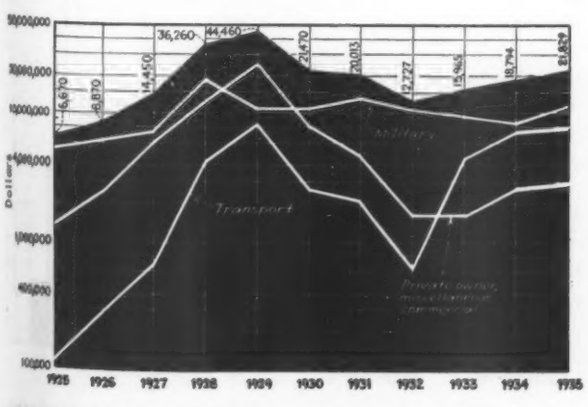
All contract prices include spares. All contract prices except Douglas transports are for planes without engines.

Typical is the case of Ryan Aeronautical, which received one order for fifteen airplanes for spring delivery that exceeded its total 1935 output.

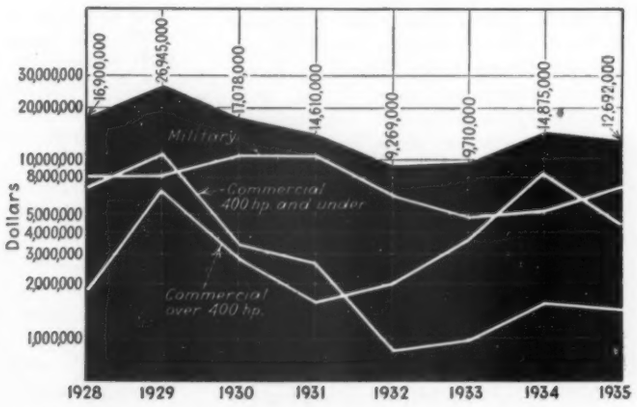
No strikingly new developments took place in design during 1935, either in transport or in private owner ships. All-metal construction, retractable landing gears, and trailing edge flaps were common features for the larger types. A notable exception is Stinson's Model A transport in which steel-tube, fabric-covered construction has been retained. Mixed construction (steel tube fuselages, steel dural or wood framed wings, and fabric covering), fixed landing gears was generally the rule in smaller ships. Exceptions,—Luscomb's Phantom, Curtiss-Wright's Coupé, Ryan's ST, where sheet metal is used extensively. Many of the latter continued the use of trailing edge flaps, a trend which began well in 1934.



A development which bore no commercial fruit in 1935 but may influence next year's production was the Bureau of Air Commerce's light plane competition. Extensive experimental work was carried out on such radically new types as the Waterman Arrowplane, the Hammond Model Y, and the roadable autogiro, but apart from experimental models there was no production.



AIRPLANE PRODUCTION IN DOLLARS. Rising steadily, the total surpasses the 1930 mark.



VALUE OF ENGINE PRODUCTION. Increase in military engine manufacture could not outweigh commercial losses.

Curtiss Wright, on the other hand, produced the CW Coupé to Department of Commerce specifications, announced its readiness to deliver to customers.

Toward the end of last year, in order to discover what the industry thought about the Bureau of Air Commerce light plane program, AVIATION circulated a questionnaire, compiled results in the December issue. The questionnaire disclosed a great deal more interest in the program than was generally supposed to exist. Outstanding among the results was marked interest in at least three of the Department's projects, (a) the use of automobile engines for aircraft (see below); (b) three-wheeled landing gear; and (c) the roadable autogiro. Of the three, considerable current interest seems to be in the three-wheeled landing gear. There are a number of ships on engineering drafting boards incorporating this feature. Interest is not confined to the smaller airplanes, but extends all the way up the line to the largest transports.

Another product of the questionnaire was a general specification for private owner requirements written by some 300-odd manufacturers, owners, and users. The concensus of opinion centered on a two or three-place airplane landing at 40 m.p.h., with a top speed of about 115 m.p.h. and a range of 500 miles.

Engines

As usual, engine production follows the airplane picture closely. Surprisingly enough, a few OX's still show up. Continental appears to be leader in the low horsepower field due largely to the use of the A-40 in Taylor Cubs. Aeronca made a good second. P & W Wasps and Wright Cyclones about divided the honors for transport plane power (in Boeing 247-Ds and Douglas DC2s).

Of note was the interest in automobile conversions (fostered by the Bureau of Air Commerce development program). Fahlin tested and flew a Plymouth power plant, and a number of Ford V-8 conversions have been reported. Casey Jones School of Aeronautics tested an Essex engine, with a belt driven propeller. Automobile engine conversions show high weights per hp., but they have the great virtue of low first cost and cheap parts replacement. They appear, on test, to be sufficiently reliable for aeronautic use. How far they will be adopted for flight use remains, however, problematical.

The military

Although Army and Navy appropriations for aircraft showed recovery in 1929 levels in 1935, and spectacular upping to all-time highs for 1936 and 1937, the actual performance in terms of production and deliveries for the year 1935 was disappointing. The Navy received some ships for replacement, the Army practically none. The new procurement programs, however, inaugurated last year, are beginning to show signs of making some progress in early 1936. Factories are busy on contracts placed since Dec. 1, 1934 (see table) and it is expected that new equipment will be coming into the hands of service squadrons at a reasonably good rate during the rest of this year. In view of the position of the United States in the chart of World Air Power (page 77), the need for the new equipment appears to be very acute.

Beyond the contracts listed in the table as already placed, new bids have just been asked for a number of observation, training, and cargo carriers for the Air Corps (see News Section). Also, openings are now due on the pursuit competition postponed from last fall. It seems unlikely, however, that deliveries on any of these last items can be expected in 1936.

Both the Army and the Navy have announced five-year procurement programs, the Army's to lead to 4,000 active airplanes by 1941, the Navy's limit being about 2,000. As shown on page 76 Army and Navy together have 1,900 airplanes on hand at the moment, 1,045 more actually on order. How these figures will stack up in terms of the growing air forces of other Powers may be seen on page 77.

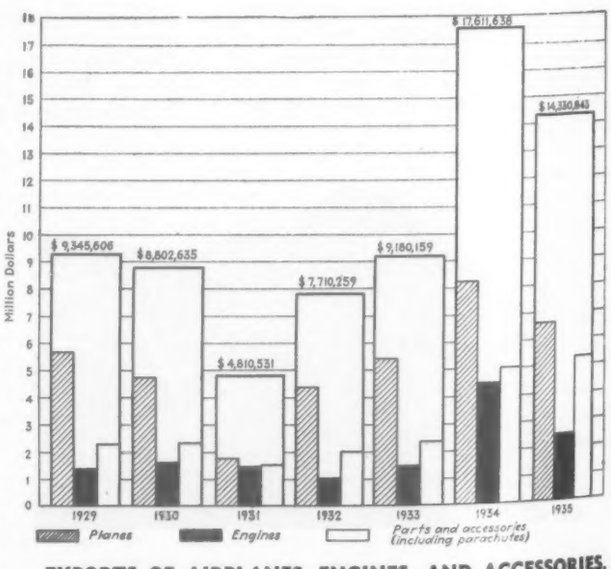
The export market

Although aeronautical exports dropped back from last year's high, they still total better than $14,000,000. Airplanes and engines lost ground materially (they now come under the all-inclusive munitions-of-war definition by presidential proclamation), but accessories continue to climb. With the military situation in the world at large in such delicately balanced condition, it seems likely that governmental control imposed upon munitions exports will further cut down the value of aircraft exportation for 1936. Most accessories, however, come in a non-military category, and with the increased building of aircraft abroad, and with the ever increasing acceptance of the excellence of American aircraft products, there is every reason to expect that overseas shipments of apparatus of this sort will continue to climb to new highs.

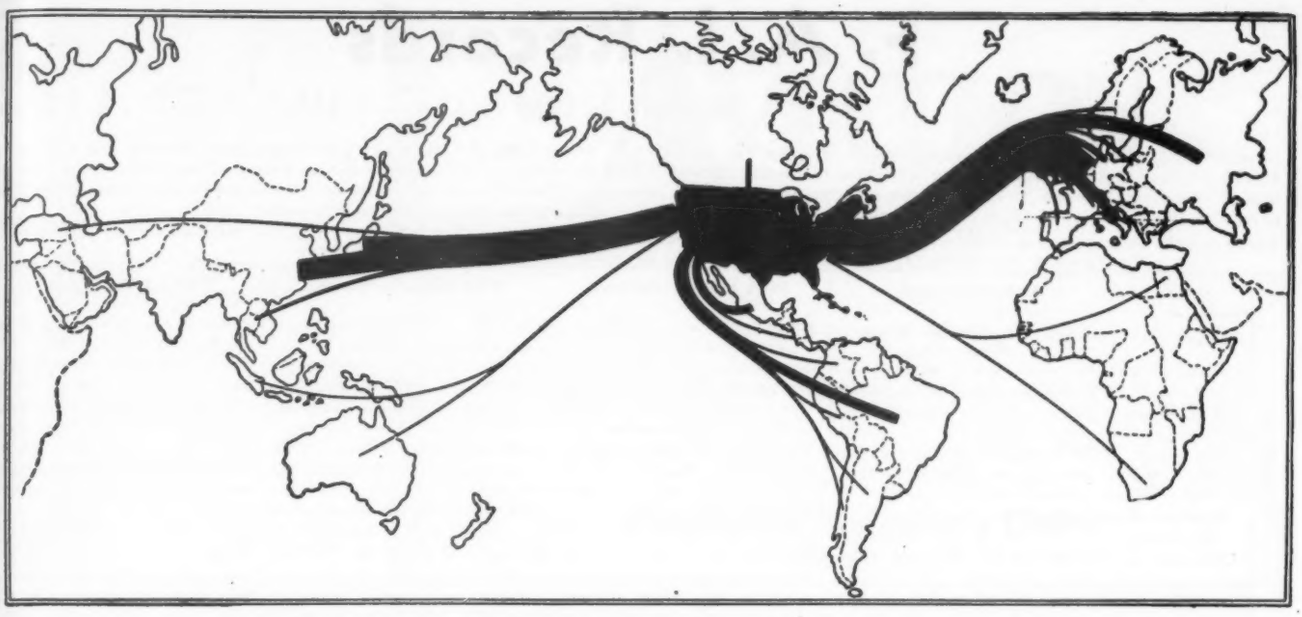
Where most of the aeronautical materials went during the year 1935 can be seen from the map. A glance at the table indicates that our best individual customers are Soviet Russia, The Netherlands, and China.

The relatively large amount of business done in The Netherlands can be accounted for chiefly by the fact that Mr. Anthony Fokker acquired the rights to distribute (and/or build) Douglas transports in Europe. The total figure given for The Netherlands, therefore, does not necessarily represent equipment used in The Netherlands, but rather exported through Holland for general use abroad. The Royal Dutch Airlines (KLM) is, however, a good individual customer as it has taken over a number of Douglas transports for its own use on its Colonial services.

The Far East still holds attractions for our export markets. Asia totalled over $4,000,000 worth of business last year, was second only to Europe. As has been pointed out, China is one of our best customers and reports indicate that she looks with increasing favor on American equipment both for her commercial airlines and for her rapidly growing military air forces. Japan, on the other hand, appears to be slipping as an export market for the United States. Recent reports indicate that German equipment is finding increased use, particularly with the military people. In view of rapidly shifting alliances and the realignment of world forces this is not an altogether unexpected trend.



EXPORTS OF AIRPLANES, ENGINES, AND ACCESSORIES. Although exports have receded from the all time high of 1934, they are still well above the mark for 1929.



WHERE AIRPLANES AND ENGINES GO. The width of each line indicates the relative dollar value of our exports in 1935.

1935 AERONAUTICAL EXPORTS

Destination	Planes		Engines		Parachutes	Parts and Accessories	Total
	No.	Value	No.	Value	Value	Value	Value
Canada	**8**	**$104,928**	**46**	**$54,491**	**$229**	**$239,678**	**$399,326**
Mexico	**22**	**521,799**	**34**	**69,565**	.....	**48,225**	**639,589**
Central America	**15**	**76,705**	**26**	**30,314**	.....	**107,085**	**214,104**
West Indies	**4**	**130,235**	**28**	**74,600**	**1,807**	**48,845**	**255,211**
South America*	**109**	**1,065,577**	**93**	**367,663**	**18,607**	**911,803**	**2,363,645**
Argentina	13	87,412	27	124,752	18,307	171,480	401,951
Bolivia	...	.....	1	930	.....	22,244	23,174
Brazil	77	538,598	42	149,926	.....	242,549	931,073
Chile	8	165,667	2	8,300	.....	71,710	245,677
Colombia	4	81,000	8	29,847	.....	186,068	296,915
Ecuador	5	42,900	...	.....	.....	2,726	45,626
Peru	2	150,000	10	49,065	.....	208,981	408,046
Asia*	**102**	**2,272,164**	**113**	**441,025**	**26,077**	**1,380,917**	**4,120,416**
China	81	1,645,062	80	264,693	3,012	609,771	2,522,538
Honkong	4	16,782	5	24,560	6,696	20,505	68,543
Japan	4	242,161	25	141,339	3,066	563,535	950,101
Siam	12	319,200	...	.....	3,000	132,662	454,862
Turkey	1	43,000	3	10,433	10,303	48,796	112,532
Europe*	**61**	**2,405,364**	**194**	**1,330,449**	**111,581**	**1,867,890**	**5,714,078**
Belgium	1	5,325	...	.....	.....	34,153	39,478
Czechoslovakia	...	.....	2	16,540	.....	9,071	25,611
Finland	...	.....	1	410	.....	10,659	11,776
France	1	30,000	1	6,969	.....	118,352	155,321
Germany	1	72,179	7	55,349	.....	67,936	195,464
Italy	3	14,552	63	549,310	.....	225,964	789,826
Netherlands	26	1,381,816	22	131,339	.....	308,574	1,821,729
Poland and Danzig	3	193,684	4	29,690	550	92,952	316,876
Portugal	...	.....	1	1,155	4,250	6,371	11,776
Rumania	...	.....	...	.....	96,480	8,774	105,254
Soviet Russia	2	179,719	21	120,183	315	720,301	1,020,518
Spain	4	200,345	5	24,169	8,893	17,859	251,266
Sweden	...	.....	11	78,745	.....	75,416	154,161
Switzerland	4	233,737	6	38,495	275	54,231	326,738
United Kingdom	14	82,507	48	277,905	360	99,673	460,445
Yugoslavia	1	9,500	...	.....	.....	3,671	13,171
Oceania*	**5**	**23,715**	**23**	**52,877**	**3,154**	**438,348**	**518,094**
Australia	...	.....	16	18,015	.....	48,556	66,571
Netherland East Indies	1	1,140	6	31,362	3,000	340,256	375,758
Philippine Islands	3	15,575	1	3,500	154	48,679	67,908
Africa*	**7**	**38,028**	**11**	**38,333**	**1,746**	**27,396**	**105,480**
Egypt	1	5,800	8	34,784	.....	6,555	47,139
Union of South Africa	5	25,228	2	3,245	.....	14,909	43,382
Total	**334**	**$6,638,515**	**568**	**$2,459,317**	**$163,201**	**$5,069,810**	**$14,330,843**

*Total includes exports to miscellaneous countries not listed separately.

F. A. I. Records

February 1, 1936

"World Records" recognized are: Max. Speed over 1.86 mi. course 440.7 m.p.h., Italy; Airline Distance 5,657 mi., France; Closed Circuit Distance 6,587 mi., France; Altitude 72,395 ft. U. S. (Stratostat); Circuit of World and Refueling Distance not yet established. The following tables are abstracted from official lists of what are termed "International Records." The first figure gives the record itself, the initial the nationality of the record holder. The make of the plane used and the horsepower of the engine follow. The F. A. I., also recognizes helicopter, autogiro, airship, balloon, glider, inter-city and feminine marks.

Figures in *italics* indicate American record when same is not the international mark.

Landplanes

	Without Payload	With 1,102 lb. Payload	With 2,205 lb. Payload	With 4,409 lb. Payload
Altitude	47,352 ft., It., Caproni, 600 hp. *43,166 ft., Wright, 450 hp.*	33,743 ft., Fr., Breguet, 620 hp. *28,143 ft., TP-1, 400 hp.*	29,462 ft., Fr., Breguet, 620 hp. *20,820 ft., Bach, 300 hp.*	27,684 ft., It., Savoia, 1,650 hp. *6,722 ft., Barling, 2,400 hp.*
Speed over 621 mi. circuit	279.8 m.p.h., Fr., Caudron, 360 hp. *191.6 m.p.h., Douglas, 1,420 hp.*	242.5 m.p.h.. Fr., I-Mago, 375 hp. *191.6 m.p.h.,, Douglas. 1,420 hp.*	242.5 m.p.h., It., I-Mago, 375 hp. *191.6 m.p.h., Douglas, 1,420 hp.*	242.5 m.p.h., It., I-Mago, 375 hp. *191.6 m.p.h., Douglas, 1,420 hp.*
Speed over 1,243 mi. circuit	236.7 m.p.h., It., I-Mago, 375 hp. *190.9 m.p.h., Douglas, 1,420 hp.*	236.7 m.p.h., It., I-Mago, 375 hp. *190.9 m.p.h., Douglas, 1,420 hp.*	236.7 m.p.h., It., I-Mago, 375 hp. *190.9 m.p.h., Douglas, 1,420 hp.*	236.7 m.p.h., It., I-Mago, 375 hp. *190.9 m.p.h., Douglas, 1,420 hp.*

Other records without payload: Distance, airline, 5,657 mi., Fr., Bleriot, 500 hp., *5,012 mi. Bellanca, 300 hp.*; Distance, closed circuit, 6,587 mi., Fr., Bleriot, 500 hp., *2,516 mi., T-2, 375 hp.;* Broken line distance 5,658 mi., Fr., Bleriot-Zapata, 500 hp., *No U. S. mark established;* Speed over 1.86 mi. straightaway, 352 m.p.h., U. S., Hughes, 1,000 hp.; Speed over 62 mi. circuit, 295.9 m.p.h., Fr., Caudron, 300 hp., *266 m.p.h., Wedell-Williams, 800 hp.*

Seaplanes

Altitude	38,559 ft., U. S., Wright "Apache," 425 hp.	31,273 ft., Fr., Liore, 1,000 hp., *26,929 ft., Sikorsky, 840 hp.*	29,081 ft., Fr., Liore, 1,380 hp., *26,929 ft., Sikorsky, 1,150 hp.*	24,629 ft., Fr., Liore, 1,380 hp. *19,709 ft., Sikorsky, 850 hp.*
Speed over 621 mi. circuit	165 m.p.h., U. S., Martin, 1,400 hp.	165 m.p.h., U. S., Martin, 1,400 hp.	165 m.p.h., U. S., Martin, 1,400 hp.	157.5 m.p.h. U. S., Sikorsky, 2,680 hp.
Speed over 1,243 mi. circuit	157.3 m.p.h., U. S., Sikorsky, 2,680 hp.	157.3 m.p.h., U. S., Sikorsky, 2,680 hp.	157.3 m.p.h., U. S., Sikorsky, 2,680 hp.	157.3 m.p.h., U. S., Sikorsky, 2,680 hp.

Other records without payload: Distance, airline, 3,281 mi., U. S. Consolidated, 1,650 hp.; Broken line distance 3,443 mi., U. S., Consolidated, 1,650 hp.; Speed over 1.86 mi. straightaway, 440.6 m.p.h., It., Macchi, 3,100 hp., *245.7 m.p.h., Curtiss, 600 hp.;* Speed over 62 mi. circuit, 391 m.p.h., It., Macchi, 2,400 hp., *241.6 m.p.h., Curtiss, 700 hp.*

Amphiblans

Altitude	18,642 ft., U. S., Sikorsky, 300 hp.	17,877 ft., U. S., Grumman, 710 hp.	Not recognized	Not recognized
Speed over 621 mi. circuit	99.9 m.p.h., U. S., Sikorsky, 300 hp.	No marks established	Not recognized	Not recognized
Speed over 1,243 mi. circuit	No marks established	No marks established	Not recognized	Not recognized

Other records without payload: Distance, airline, 1,033 mi., U. S., Douglas, 1,500 hp.; Broken line distance—No marks established; Speed over 1.86 mi. straightaway, 230.4 m.p.h., U. S., Seversky, 710 hp.; Speed over 62 mi. circuit, 173.9 m.p.h., U. S., Grumman, 710 hp.

Light Landplanes

	Multiplace Under 1,235 lb. Empty	Single-place Under 992 lb. Empty	Multiplace Under 617 lb. Empty	Single-place Under 441 lb. Empty
Distance (Airline)	1,809 mi., Fr., Farman, 95 hp. No U. S. mark established	2,226 mi., Pol., R.W.D., 130 hp. *1,650 mi., Barling, 60 hp.*	551 mi., It., N. S., 75 hp. No U. S. mark established	529 mi., Fr., Maubaussin, 40 hp. *449 mi., Aeronca, 26 hp.*
Altitude	30,453 ft., It., Fiat, 180 hp. *18,543 ft., Inland, 110 hp.*	32,834 ft., It., C.N.A., 160 hp. *24,075 ft., Barling, 90 hp.*	22,805 ft., It., N-5, 75 hp. *13,924 ft., Curtiss-Wright, 43 hp.*	17,037 ft., Fr., Maubaussin, 40 hp. *17,467 ft., Aeronca, 38 hp.*
Speed over 62 mi. circuit	281.9 m.p.h., Fr., Caudron, 325 hp. *172.2 m.p.h., Monocoupe, 145 hp.*	222.8 m.p.h., U. S., Chester Special, 200 hp.	138.3, It., N-5, 75 hp. No U. S. mark established	137.5 m.p.h., U. S., Wittman, 95 hp.
Speed over 311 mi. circuit	Not recognized	Not recognized	132.7, It., N-5, 75 hp. No U. S. mark established	No marks established
Speed over 621 mi. circuit	181.9 m.p.h., Fr., Caudron, 140 hp. No U. S. mark established	206.8 m.p.h., Fr., Caudron, 150 hp. No U. S. mark established	121.6 m.p.h., Fr., Farman, 75 hp. No U. S. mark established	No marks established

Speed over 1,243 mi. circuit recognised but not established for 1,235 and 992 lb. categories.

Light Seaplanes

	Multiplace Under 1,499 lb. Empty	Single-place Under 1,257 lb. Empty	Multiplace Under 772 lb. Empty	Single-place Under 551 lb. Empty
Distance (Airline)	76 mi., Fr., Farman, 95 hp. No U. S. mark established	221 mi., U. S., Aeronca, 36 hp.	185 mi., U. S., Aeronca, 36 hp.	230 mi., U. S., Aeronca, 36 hp.
Altitude	24,153 ft., It., Fiat, 140 hp. No U. S. mark established	27,595 ft., It., C.N.A., 160 hp. No U. S. mark established	11,558 ft., U. S., Aeronca, 36 hp.	15,082 ft., U. S., Aeronca, 36 hp.
Speed over 62 mi. circuit	117.7 m.p.h., Fr., Farman, 95 hp. No U. S. mark established	102.5 m.p.h., Ger., Junkers, 85 hp. No U. S. mark established	89 m.p.h., Fr., Farman, 40 hp. No U. S. mark established	80.9 m.p.h., U. S., Aeronca, 36 hp.
Speed over 311 mi. circuit	Not recognized	Not recognized	No marks established	70.4 m.p.h., U. S., Aeronca, 36 hp.

Speed over 621 mi. circuit recognized but not established all categories; Speed over 1,243 mi. circuit recognized but not established for 1,499 and 1,257 lb. categories.